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Your Beauty Guide App: Smart Makeup Assistant

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Abstract

The Your Beauty Guide App: Smart Makeup Assistant is an AI-powered solution designed to simplify makeup selection for diverse skin tones and types, eliminating mismatched products and unreliable advice. Using AI, it analyzes skin tone, type, and facial structure to offer personalized recommendations and techniques, enhancing natural beauty and inclusivity. Developed via the Waterfall Model (analysis, design, implementation, testing, maintenance), the app ensures systematic progress. Built with Flutter, it supports cross-platform use on Windows 11 and mobile devices. Key features include skin detection, tailored recommendations, and history tracking, reducing reliance on biased beauty advisors. Development involved UML diagrams, database schemas, and UI mockups, followed by AI integration and rigorous testing for accuracy. The app successfully minimizes trial-and-error purchases, offering a user-centric, AI-driven beauty experience. Future enhancements may include expanded AI learning and advanced customization, showcasing how technology can make makeup selection inclusive, efficient, and personalized.

1. Introduction

Makeup has long been an essential tool for enhancing women's beauty. Currently, individuals seeking makeup assistance typically consult beauty advisors, who must be knowledgeable about various cosmetic products. A beauty advisor's responsibilities include demonstrating makeup techniques, recommending products tailored to clients' needs, and educating customers about product details such as ingredients, application methods, and pricing [1]. However, beauty advisors may sometimes recommend unsuitable products due to marketing agreements or other biases. Many users struggle to find makeup that complements their unique skin type and tone, often resulting in unnecessary spending on incompatible products. In today's digital era, there is a growing need for accessible, technology-driven makeup assistance. This demand has led to the integration of Artificial Intelligence (AI) in the beauty industry. AI refers to technology that enables machines and computers to simulate human-like learning, comprehension, problem-solving, decision-making, creativity, and autonomy [2].

In the beauty industry, many people depend on beauty advisors for help with makeup, but this has its challenges. Beauty advisors sometimes suggest products not because they are the best fit, but because of marketing deals. Another issue is that many people find it hard to choose the right makeup for their unique skin type and tone. This leads to wasted money on unsuitable products or struggles with applying makeup that highlights their natural beauty. To address these challenges, Your Beauty Guide App: Smart Makeup Assistant is proposed. This app will make it easier for users to pick the right products and techniques, offering inclusivity and personalized solutions for everyone. The objectives of this system are firstly to design a Smart Makeup Assistant

Application using an object-oriented approach. This approach ensures that the project follows a structured flow through phases of the software development life cycle. The application will be developed using Android technology to ensure compatibility with many mobile devices and lastly the system functionalities will be thoroughly tested to ensure it performs effectively.

The proposed system is about the mobile application system Makeup Assistant application with AI. The users involved in this proposed mobile application are the client and administrator. This project implements the Waterfall methodology because of its clear and easy-to-follow structure in software development, which aligns with the project requirement. The system consists of six modules which are register and login, manage profile, landing page, detect skin, manage result and manage product. A client can sign up, log in, edit their own details, view announcements, choose skin type, colour and face shape, receive suggested makeup product and technique that suits them, can leave rate and review and view history too. While the administrator can log in, add new announcement, view total reviews and active announcements, can manage product reviews.

There are five sections included in this paper. Section 1 describes the project background, Section 2 discusses the related work, Section 3 describes the methodology used to develop the system, Section 4 presents the result and discussion of the system and Section 5 shows the conclusion of the project.

2. Related Work

This study will be discussing application named Your Beauty Guide App: Smart Makeup Assistant, and the existing process of Makeup Assistant. In this part, it discussed about the technology used in the system. Besides that, three types of existing system will be study and proposed system will be compared.

2.1 Technology Used

This section gives an overview of the main technologies used in the application. It includes Flutter is use for developing natively compiled applications for mobile, web, and desktop platforms using a single codebase. The application also uses Android, a widely used mobile operating system, which ensures the app works smoothly on many devices. In addition, the app incorporates a Decision Support System (DSS), which helps process data and provide users with helpful, personalized recommendations.

2.2 Comparison between related system

Based on the research, three existing systems are identified. Firstly, Smudg is an innovative app for discovering suitable makeup and skincare products based on individual needs, but it provides limited personalized product suggestions. Secondly, Tira: Online Beauty Shopping is a beauty shopping app designed to accompany on journey of self-expression and self-discovery but it lacks detailed guidance tailored to help beginner makeup users. Lastly, Color Analysis & AI Stylist is an AI-powered beauty and style app but requires a subscription for users to access detailed recommendations on makeup that best suited to them. By analyzing the three existing system's functionality, strengths, and weaknesses with the proposed Your Beauty Guide App: Smart Makeup Assistant, developers can identify effective strategies, avoid previous mistakes, and provide optimal solutions. This approach not only improves the design and performance of new systems but also ensures that they align with user needs and adhere to industry standards. Table 1 shows the comparison between existing and proposed application.

Table 1 *Comparison between existing and proposed application*

Features	Smudg	Tira: Online Beauty Shopping	misi: Color Analysis & AI Stylist	Your Beauty Guide App: Smart Makeup Assistant
Register and Login	√	√	√	√
Manage Profile	χ	√	χ	√
Access Homepage	χ	√	χ	√
Detect Skin	√ but no survey about face shape	χ	√ but no survey about face shape	√

Table 1 *(cont)*

Manage Result	√ Don't use AI and need to be subscribed	χ	√ Need to be subscribed	√
Manage Product	χ	√	χ	√

3. Methodology

The Waterfall Model is referred to be a liner sequential life cycle model [3]. The chosen methodology for this system application is Waterfall Model. Waterfall Model is used in this project because the requirements for this project are clearly outlined and the objectives are well-defined [4]. Waterfall model has many advantages to why is important in this project, the waterfall model is straightforward to manage. Next, waterfall model works well particularly for smaller projects with clearly defined requirements. There are five important phases that is included in Waterfall Model which is analysis, design, implementation, testing, and maintenance. Table 2 shows Software development activities and their task.

Table 2 *Software development activities and their task*

Phase	Task	Output
Analysis	-Proposed the project	-Project proposal
	-Determine the project schedule, activities, and output	-Develop Gantt chart
Design	-Design use case diagram, Sequence diagram, activity diagram and class diagram	-Use case diagram
	-Design use case specification	-Use case specification
	-Design user interface	-Sequence diagram
	-Design database	-Activity diagram
		-Class diagram
		-Schema table
Implementation	-Develop the system modules using coding and database	-Fully working system modules
Test	-Test functionalities to ensure they work as expected	-Bug reports and fixes
Maintenance	-Plan for future improvement	-List for future improvement

3.1 System Requirement Analysis

Requirements analysis plays a crucial role in the System Development Life Cycle (SDLC) to ensure the success of software development projects. Various methods, techniques, and frameworks are employed to define, prioritize, and manage requirements effectively in IT projects [5]. System requirement analysis includes three main categories of requirements. First, functional requirements, which specify the particular functions and features that a system is required to perform, non-functional requirements, which describe the quality characteristics of the system, such as performance, security, and usability and user requirements, which concentrate on the needs and expectations of end-users to make sure the system meets their objectives and usability criteria. Defining functional requirements involves specifying the objective (or multiple objectives in the case of multi-objective problems) to be optimized, as well as identifying the equality and inequality constraints when addressing problems with additional side constraints [6]. Table 3 shows functional requirement and Table 4 shows non-functional requirement.

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Table 3 *Functional Requirement*

Modules	Description
Register and Login	• This module allows client to sign up new account for log in • This module allows administrator to login with their email and password. • This module allows client to reset their passwords by clicking the "Forgot Password".
Manage Profile	• This module allows client and administrator to add, edit and delete their own details.
Landing Page	• This module allows client to view any announcement makeup promotion. • This module allow client to choose any selection of makeup product. • This module allow administrator to view total review and active announcement.
Detect Skin	• This module allow client to choose which type of skin type and colour that implement to them. • This module allow client to choose which type of face shape is suitable to them.
Manage Result	• This module allows the AI to generate compatible makeup products optimised for client skin type and color. • This module allow client to know makeup techniques that is suitable for client face shape. • This module allow client to view and given review and rate about the suggested product. • This module allow client to view generated result in History page.
Manage Product	• This module allow administrator to add, view and delete product announcement. • This module allow administrator to view and delete client product review.

Table 4 *Non-functional Requirement*

Modules	Description
Performance	• The system should provide quick response for user interaction within two seconds when using the application. • The system should process a high number of simultaneous requests without significant latency.
Operational	• The system should provide a user-friendly interface.
Usability	• The app's interface should be intuitive and easy to navigate for all users. • Feature like preference input should be seamless, making user experience efficient
Security	• The system should encrypt all user data, including profile information and AI-generated recommendations, to protect user privacy.

3.2 UML Diagram

Unified Modeling Language (UML) diagrams serve as a universal set of symbols and notations designed to describe concepts clearly and support collaboration during software development [7].

3.2.1 Use Case diagram

Use case modelling is a leading technique for defining the functional requirements of a system. A use case typically includes actors to identify who will interact with the module within the system. This helps clearly illustrate the flow, with the system's name displayed as the title at the top. Figure 2 shows the use case of Your Beauty Guide App: Smart Makeup Assistant.

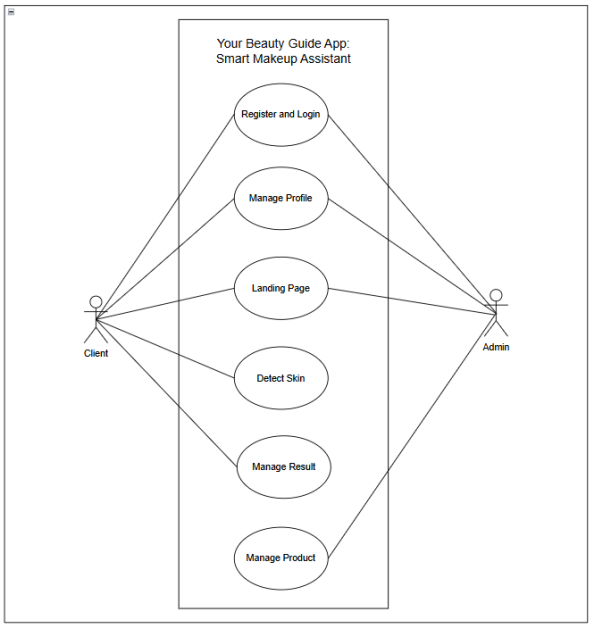

Fig. 2 Use Case of Your Beauty Guide App: Smart Makeup Assistant

3.2.2 Class Diagram

The UML is widely recognized as the standard for developing object-oriented software models [8]. UML diagrams support understanding, designing and documenting the structure and behavior of a system. Figure 3 shows the class diagram for Your Beauty Guide App: Smart Beauty Assistant.

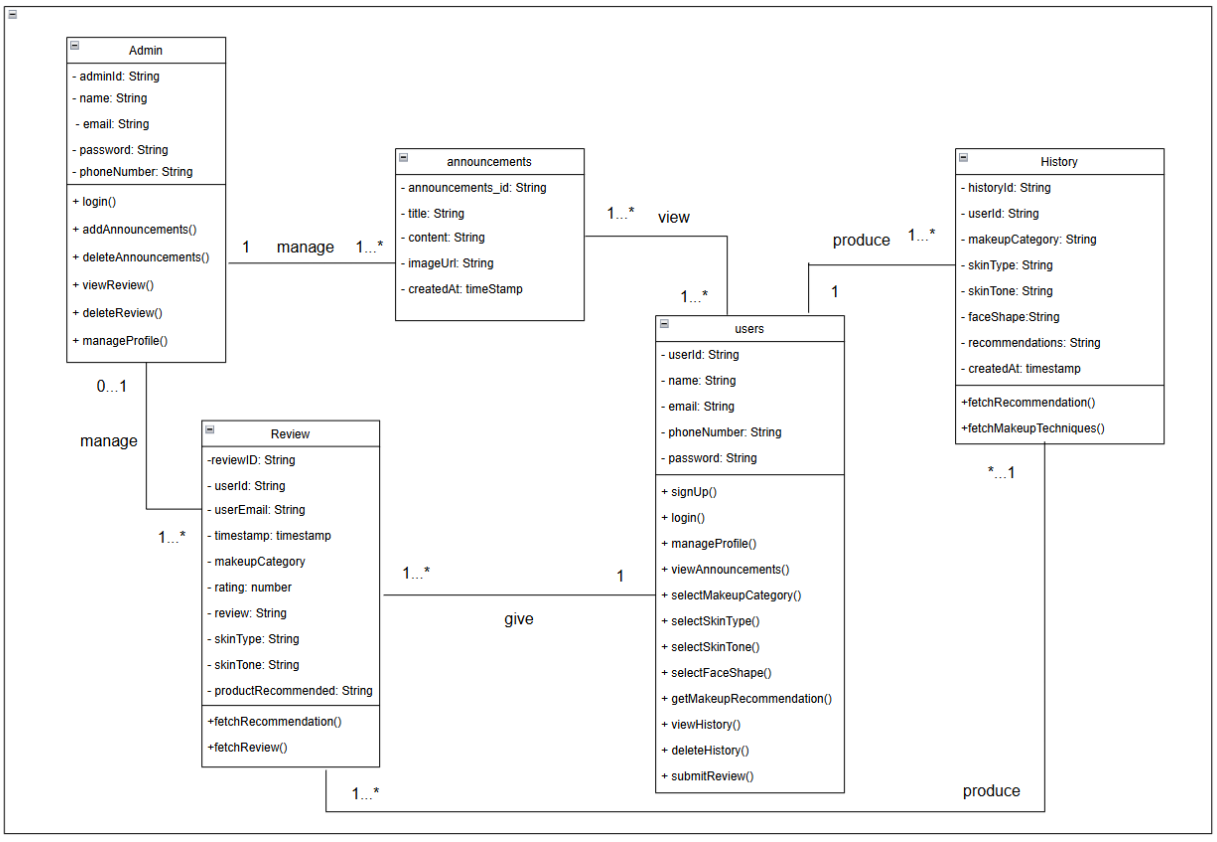

Fig. 3 Class Diagram for Your Beauty Guide App: Smart Beauty Assistant.

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3.2.3 Schema Table

The following tables have been designed and extracted from the class diagram to support the functionalities of the Your Beauty Guide App: Smart Makeup Assistant. The structure, relationships, and constraints of each table ensure data accuracy and support seamless operations throughout the system.

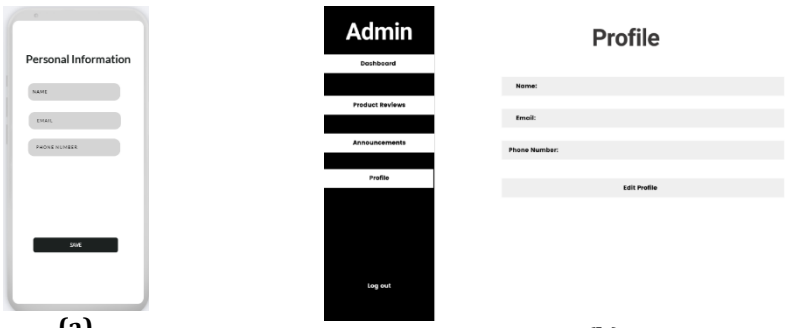
i. users `(userId(PK), name, email, phone_number, password).`
ii. admin `(adminId(PK), name, email, phone_number, password).`
iii. announcements `(announcements_id(PK), title, content, imageUrl, createdAt).`
iv. review `(reviewId(PK), userId(FK), userEmail, timestamp, rating, review, skinTone, skinType makeupCategory, productRecommended).`
v. history `(historyId(PK), userId(FK), userEmail, makeupCategory, skinType, skinTone, faceShape, recommendation, createdAt).`

3.2.4 Interface Design

The following section presents the interface design for each module of the system, providing a visual representation of the potential outcome of the mobile application. By outlining these designs, this section aims to give a clear understanding of how the application will look and function, ensuring that all user requirements are met. Fig. 4 until Fig. 9 shows that Your Beauty Guide App: Smart Makeup Assistant user interface.

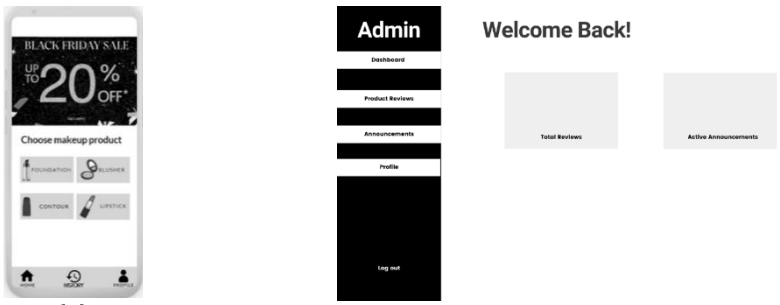
(a) **(b)** **(c)**

Fig. 4 Interface (a) Register for client (b) Login for client (c) Login for administrator



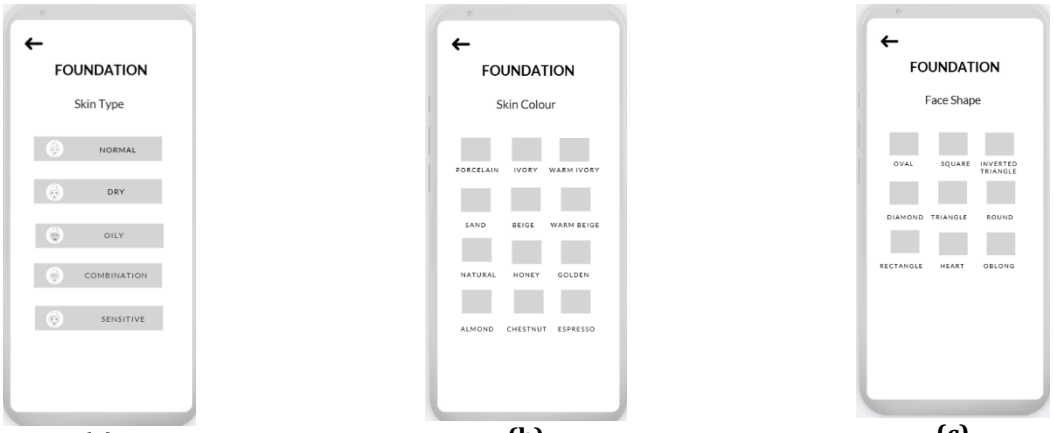
(a) **(b)**

Fig. 5 Interface Manage Profile for (a) client (b) administrator



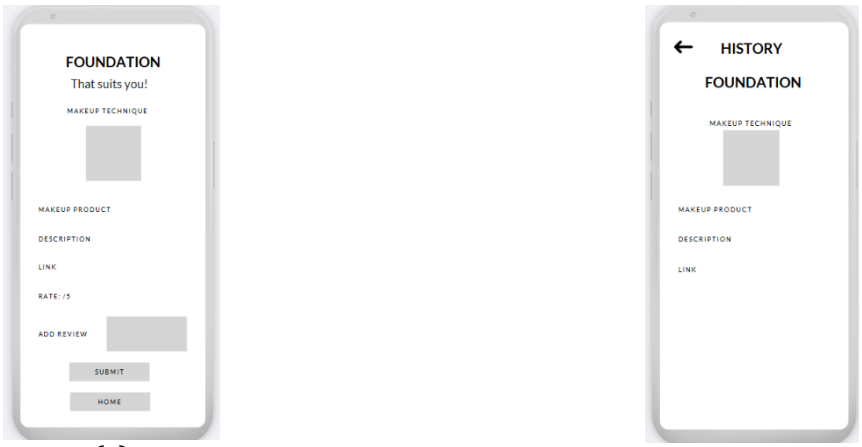
(a) **(b)**

Fig. 6 Interface Landing Page for (a) client (b) administrator



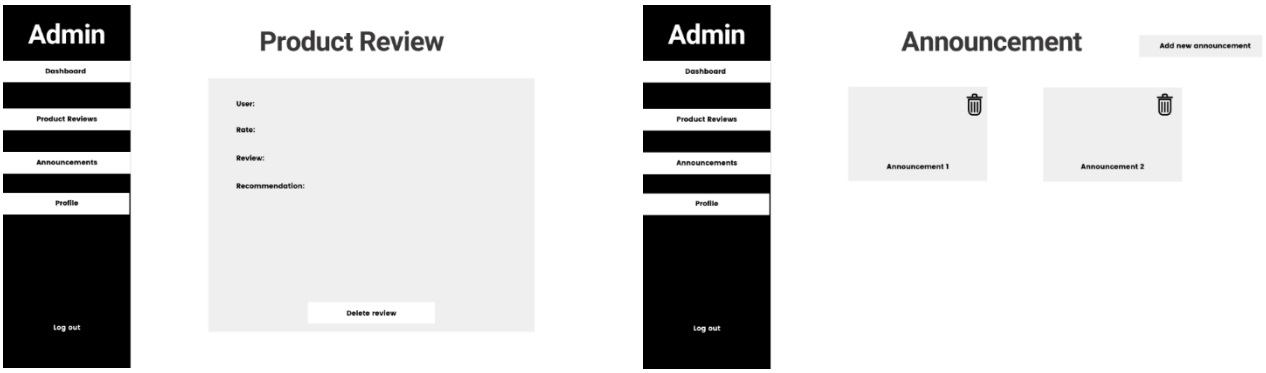
(a) (b) (c)

Fig. 7 Detect Skin Interface (a) Skin Type (b) Skin Colour (c) Face Shape



(a) (b)

Fig. 8 Interface (a) Manage Result (b) History



(a) (b)

Fig. 9 Interface (a) Manage Product Review (b) Manage Product Announcements

4. Result and Discussion

The implementation involves constructing the system according to the design plans. The process of testing involves the test cases conducted to ensure the system's reliability, functionality, and security.

4.1 Register and Login Module

To access the system, client need to register their account by entering name, email, password and confirm password. Figure 10(a) shows register interface for client. Existing client can gain access to the system by login using email and password. Administrator can gain the access to the system by login using admin email and password. Figure 10 (b) shows login interface for client and Figure 11 shows the login interface for administrator.

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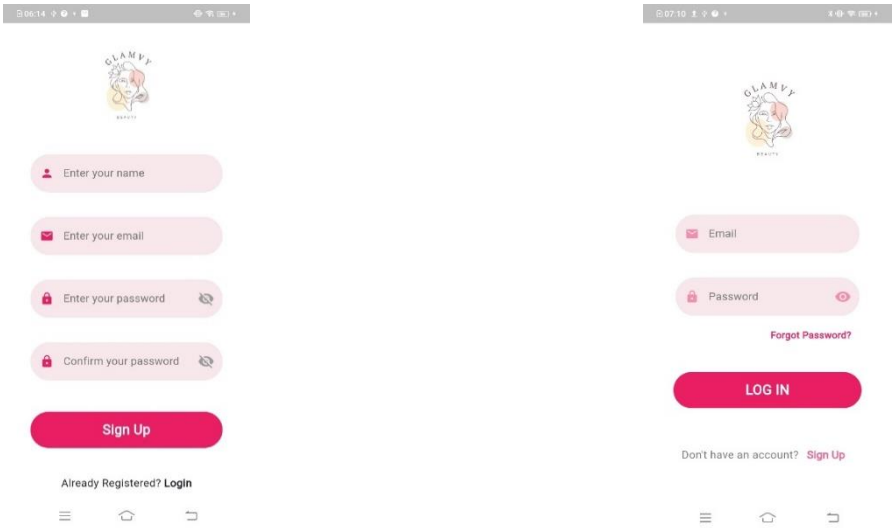

(a) **(b)**

Fig. 10 Interface (a) Register for client (b) Login for client

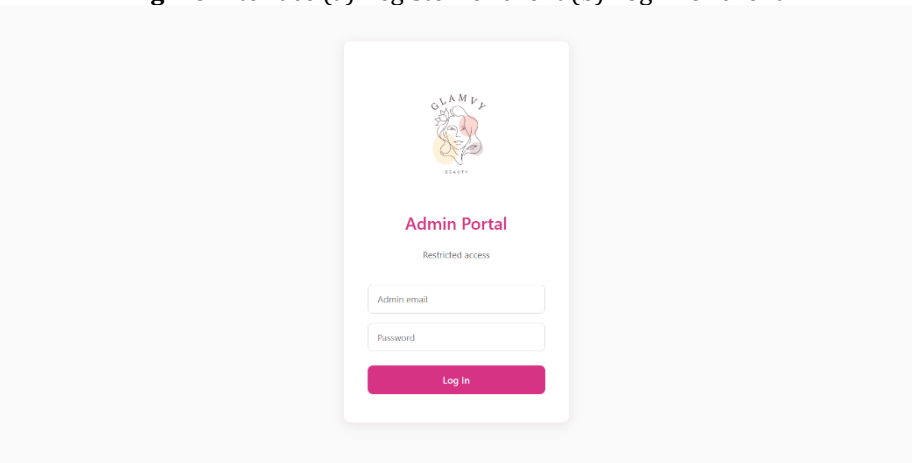

Fig. 11 Login interface for admin

4.2 Manage Profile Module

Profile is for user to update their information details. Name and email are automatically gathered during register. User can update their name and phone number. Figure 12 shows profile interface for client and Figure 13 Profile interface for administrator

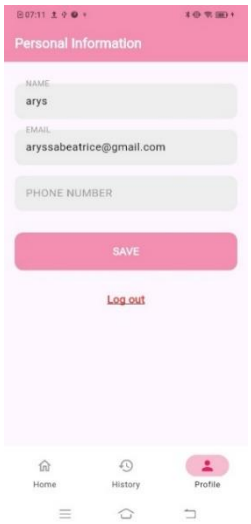

Fig. 12 Profile interface for client

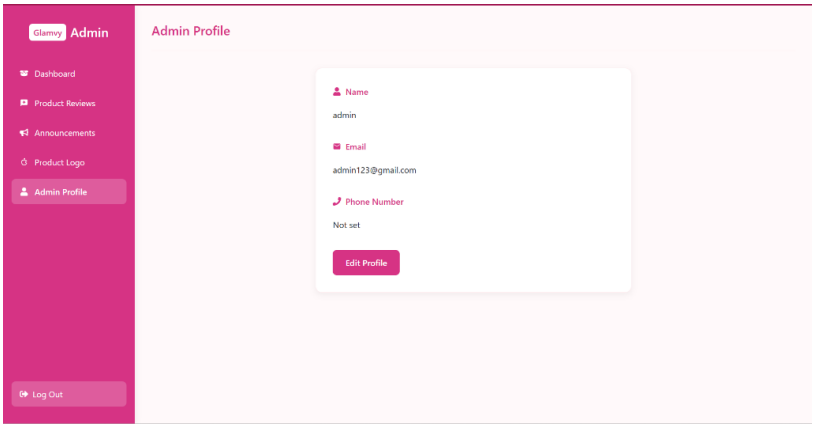

Fig. 13 Profile interface for administrator

4.3 Landing Page Module

Landing page is to display the first thing user see when they have gained access to the system. Client can view promotion on top of the page and can choose the makeup product. Administrator can view the total reviews and the active announcements. Figure14 shows the landing page interface for client and Figure 15 shows the landing page for administrator.

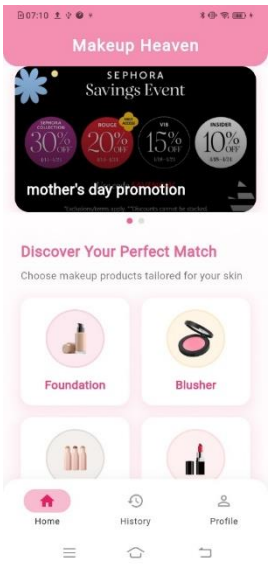

Fig. 14 Landing Page interface for client

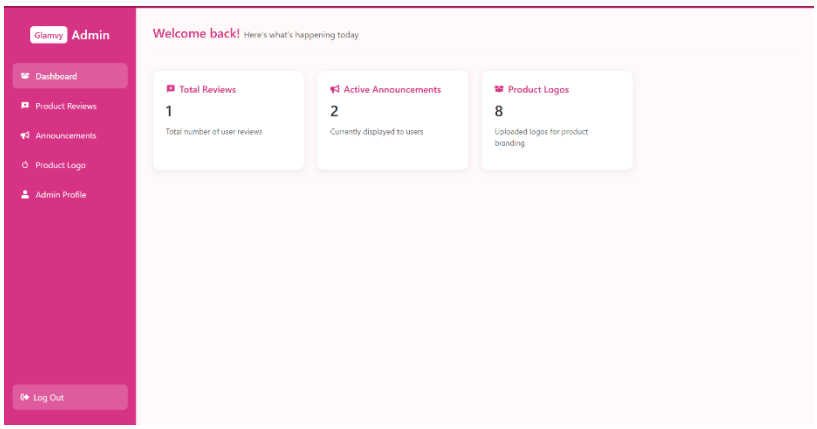

Fig. 15 Landing Page interface for administrator

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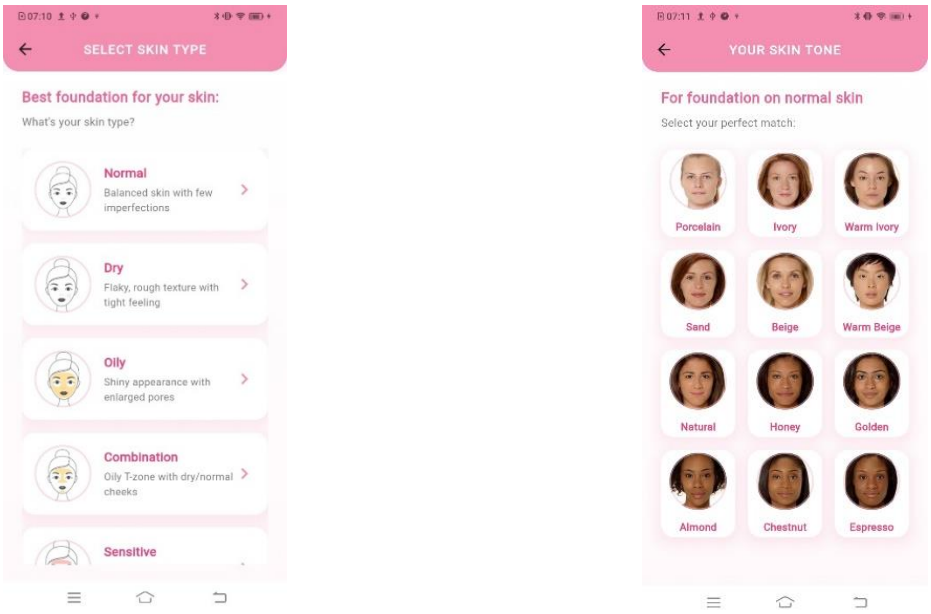
4.4 Detect Skin Module

Detect skin page is for client to choose to gain their personalised makeup recommendation that suits their skin type, skin colour and face shape. First, user need to click their skin type. Figure 16(a) shows skin type interface. Then, user need to choose their skin color. Figure 16(b) shows skin colour interface. Lastly, user need to choose their face shape. Figure 17 shows face shape interface.



(a) **(b)**

Fig. 16 Interface (a) Skin Type in Detect Skin (b) Skin Colour in Detect Skin

Fig. 17 Face Shape interface in Detect Skin

4.5 Manage Result Module

Manage result represent the system personalised makeup recommendation based on user selection from the makeup product at the landing page then their skin type, skin colour and face shape. Figure 18(a) shows result page. After they have gained their makeup recommendation user can leave rate and ratings. Figure 18(b) shows the continuation of the result page. User can also view their previous makeup recommendation at the history page. Figure 19 shows the history page.

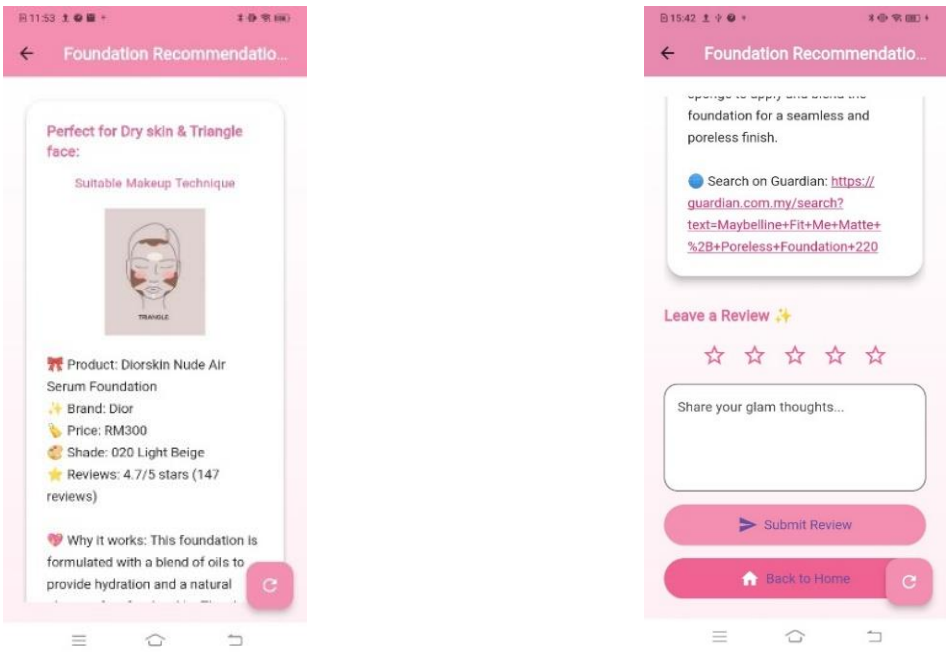


Fig. 18 Interface (a) Manage Result (b) Manage Result (Continue)

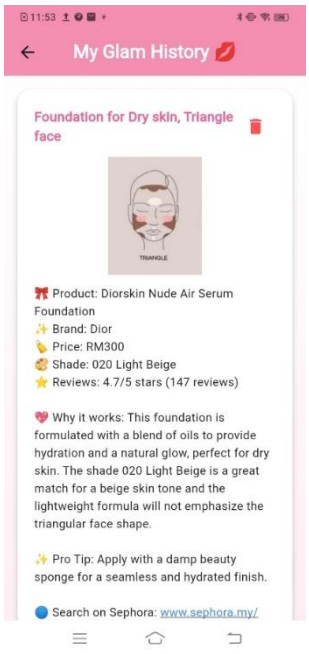


Fig. 19 History interface in Manage Result

4.6 Manage Product Module

Manage Product page is for administrator to view the details on the product review page. Administrator can view the rate and review that client give based on the personalised makeup recommendation that suits them. Administrator can also delete any user review in this page. Figure 20 shows the manage product reviews page. Administrator can view the announcement that they publish. Administrator can also add new announcement or delete existing announcement. This announcement will appear on top of client mobile application landing page, it will appear as promotion. Figure 21 shows manage product announcement page.

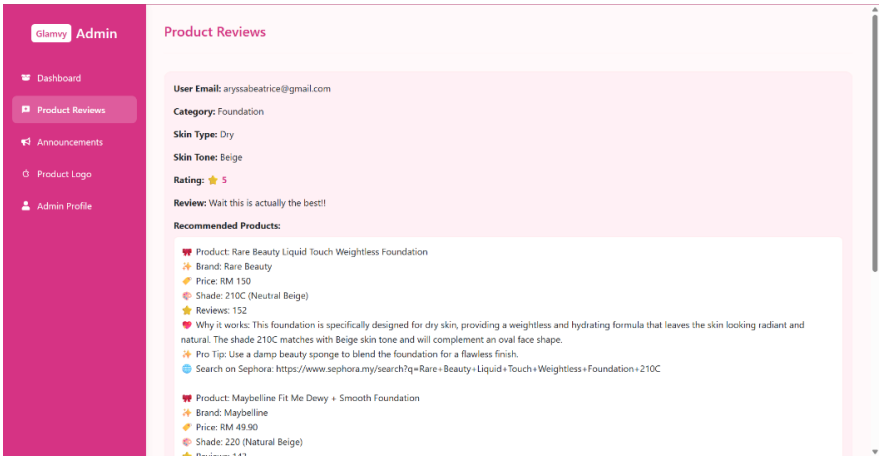


Fig. 20 Manage Product Reviews

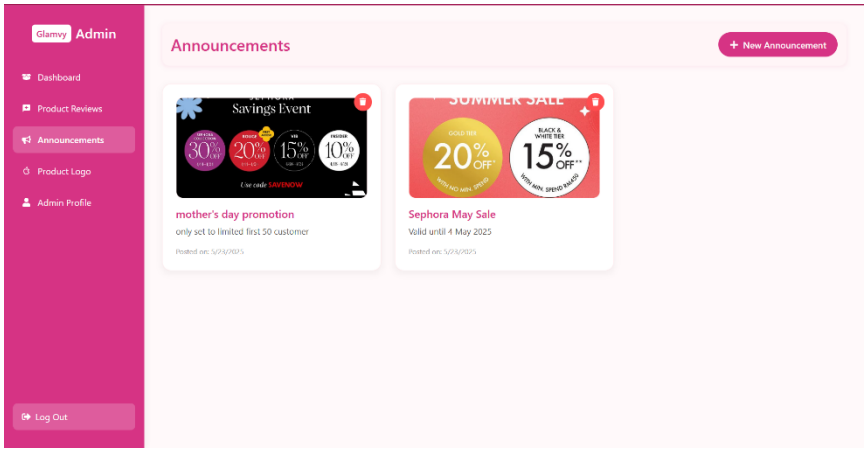


Fig. 21 Manage Product Announcement

4.7 Testing Result

After the implementation phase, the system undergoes functionality test where we can identify and address any bugs. Table 5 to Table 10 shows the test cases for each of the six modules in the system. Each test case includes test case id, test cases, expected result, actual result and the status whether test case passes or fails.

Table 5 *Register and Login test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_01_001	Enter valid email and password for login	Account login is successful.	Account login is successful.	Pass
TC_01_002	Enter name, valid email address, password and confirm password for register	Account registration is created successfully.	Account registration is created successfully.	Pass
TC_01_003	Enter invalid email and password	System displays error message.	System displays error message.	Pass
TC_01_004	Save user data to database	New entry appears in database.	New entry appears in database.	Pass
TC_01_005	Forgot Password	Password reset instructions are sent to the registered email address.	Password reset instructions are sent to the registered email address.	Pass

Table 5 *(cont)*

TC_01_006	Display landing page	System shall display landing page after login	System shall display landing page after login	Pass

Table 6 *Manage Profile test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_02_001	Access profile page	Profile page with current user details.	Profile page with current user details	Pass
TC_02_002	Edit personal details	Profile page can edit personal details.	Profile page can edit personal details.	Pass
TC_02_003	Validate updated data and save updated data to database	System shows confirmation message and new data store in database.	System shows confirmation message and new data store in database.	Pass
TC_02_004	Display confirmation message after update profile page	System displays successful message.	System displays successful message.	Pass
TC_02_005	Allow Logout from Profile page	Logout button functional.	Logout button functional	Pass
TC_02_006	Logout from system	Redirects to Login page	Redirects to Login page	Pass

Table 7 *Landing Page test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_03_001	Display promotions on landing page	Promotion appears, user can view promotion.	Promotion appears, user can view promotion.	Pass
TC_03_002	Product categorization.	Product grouped by category.	Product grouped by category.	Pass
TC_03_003	Select the product type.	User can select product type.	User can select product type.	Pass
TC_03_004	Navigate to Detect Skin interface	Detect Skin interface is displayed.	Detect Skin interface is displayed.	Pass
TC_03_005	Display total review and active announcements on landing page for administrator	Display accurate total review and active announcement.	Display accurate total review and active announcement.	Pass

Table 8 *Detect Skin test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_04_001	Select the skin type	Client can select skin type and redirect to skin colour.	Client can select skin type and redirect to skin colour.	Pass
TC_04_002	Select the skin colour	Client can select skin colour and redirect to face shape.	Client can select skin colour and redirect to face shape.	Pass
TC_04_003	Select the face shape	Client can select face shape.	Client can select face shape.	Pass

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Table 8 *(cont)*

TC_04_004	Store client selected skin type, skin colour and face shape to database	New entry appears in database.	New entry appears in database.	Pass
TC_04_005	Navigate to Manage Result page	Redirects to Manage Result page.	Redirects to Manage Result page.	Pass

Table 9 *Manage Result test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_05_001	Recommendation product match client skin type and colour	Display products match with skin type and colour.	Display products match with skin type and colour.	Pass
TC_05_002	Makeup suggestions tailored to user individual preferences	Makeup suggestions match with user preferences.	Makeup suggestions match with user preferences.	Pass
TC_05_003	Makeup Technique match with client face shape	Display makeup technique match with face shape.	Display makeup technique match with face shape.	Pass
TC_05_004	Client can rate and review recommendation product	Display successful message.	Display successful message.	Pass
TC_05_005	Blank text field for review and rate	Shows error message.	Shows error message.	Pass
TC_05_006	View generates result in History page	Results exist in History page.	Results exist in History page.	Pass

Table 10 *Manage Product test plan*

Test Case Id	Test Cases	Expected Result	Actual Result	Status
TC_06_001	View Announcement	Shows all announcements.	Shows all announcements.	Pass
TC_06_002	Add new announcement	New announcement is added and saved successfully.	New announcement is added and saved successfully.	Pass
TC_06_003	Delete announcement	Announcement is deleted successfully.	Announcement is deleted successfully.	Pass
TC_06_004	Validate product details before adding or delete	Display confirmation message.	Display confirmation message	Pass
TC_06_005	View client reviews	Display all reviews from user.	Display all reviews from user.	Pass
TC_06_006	Delete reviews	Review is deleted successfully.	Review is deleted successfully.	Pass

5. Conclusion

To conclude the development of Your Beauty Guide App: Smart Makeup Assistant, covering the system's achievements, advantages, disadvantages, and proposed future improvements. The system successfully met its objectives by developing a mobile application for clients and a web platform for admins, using object-oriented programming, Android technology (Flutter and Firebase), and functional testing to ensure reliable performance. Some of the advantages include personalized, unlimited makeup recommendations, a fast and user-friendly interface, saved history for comparison, and promotion tracking across major Malaysian stores (Sephora, Watsons, Guardian). However, some limitations exist, such as broken product links generated by AI, reliance on

users to correctly identify their skin and facial features, and outdated promotional information due to manual updates. Future enhancements proposed include enabling administrator control over AI prompts, adding guided tools to help users identify their characteristics accurately, and automating promotion updates.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Aryssa Batrisya Abdul Khalid, Suhaila Mohd Yasin;* ***data collection:*** *Aryssa Batrisya Abdul Khalid, Suhaila Mohd Yasin;* ***analysis and interpretation of results:*** *Aryssa Batrisya Abdul Khalid, Suhaila Mohd Yasin;* ***draft manuscript preparation: :*** *Aryssa Batrisya Abdul Khalid, Suhaila Mohd Yasin. All authors reviewed the results and approved the final version of the manuscript.*

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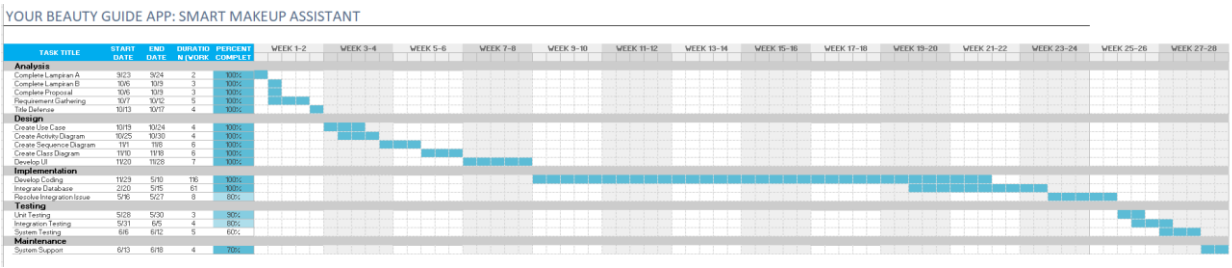
Appendix A: Gantt Chart



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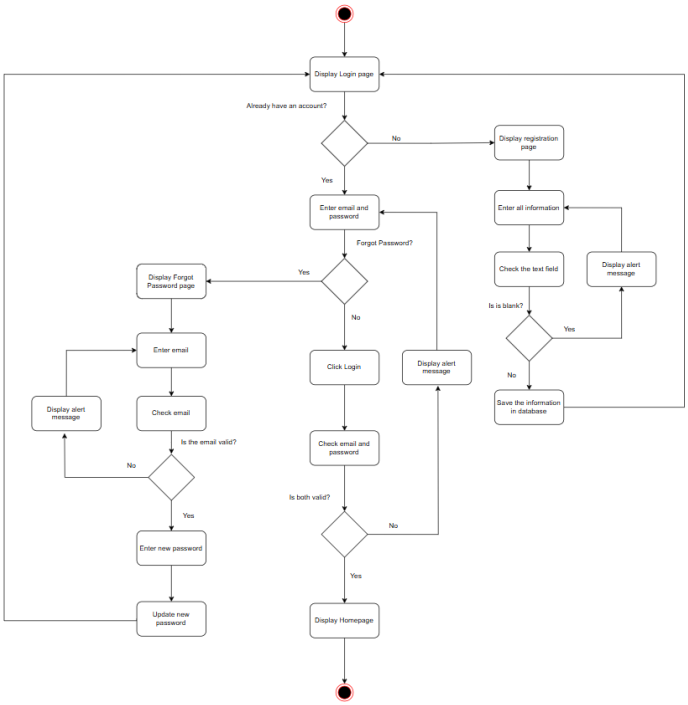
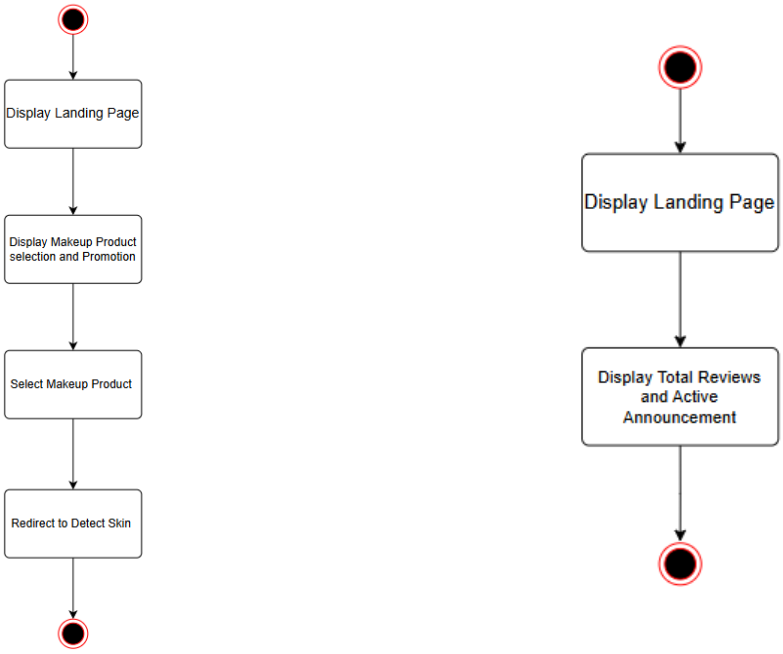
Appendix B: Activity Diagram



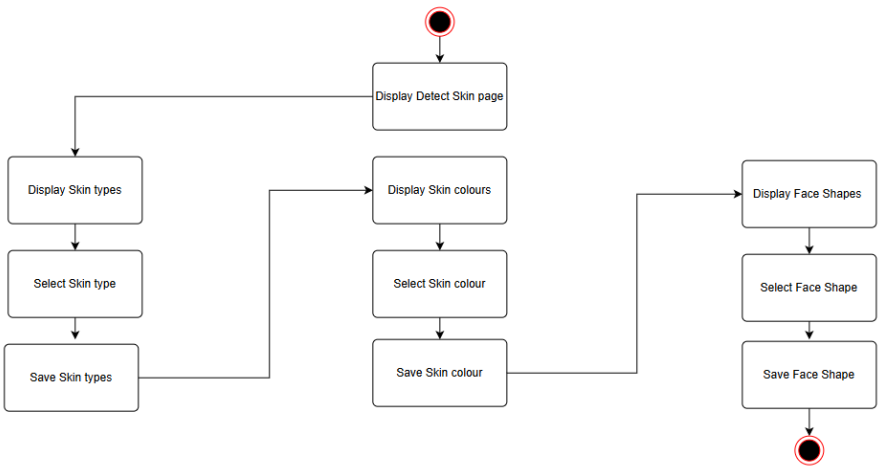
B.1: Activity Diagram for Register and Login

B.2: Activity Diagram for Manage Profile



(a) **(b)**

B3: Activity Diagram (a) Landing Page (client) (b) Landing Page (admin)



B.4: Activity Diagram for Detect Skin

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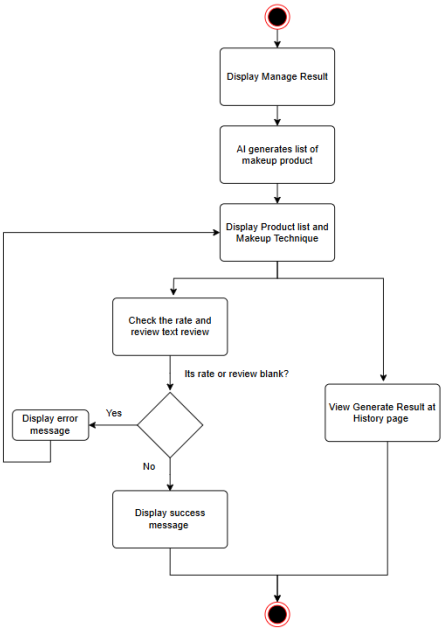
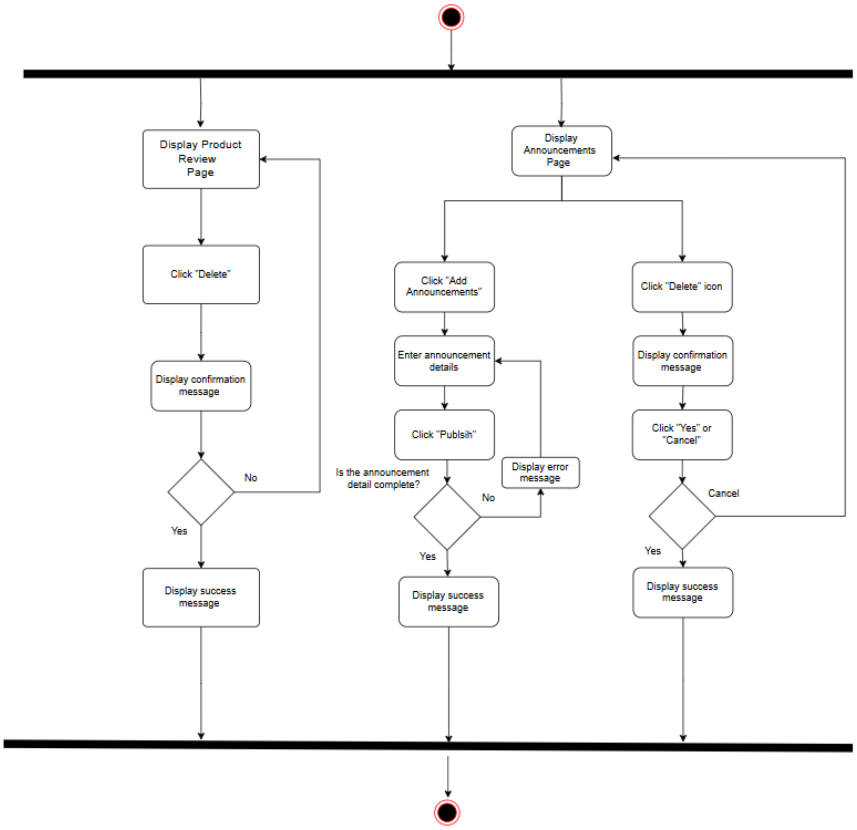
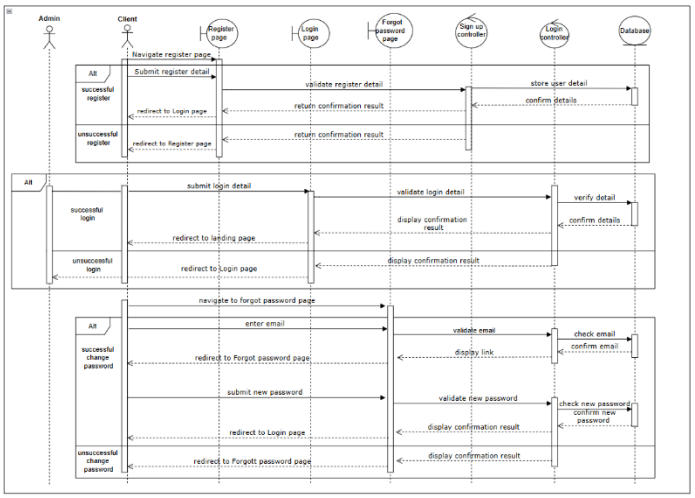


B.5: Activity Diagram for Manage Result

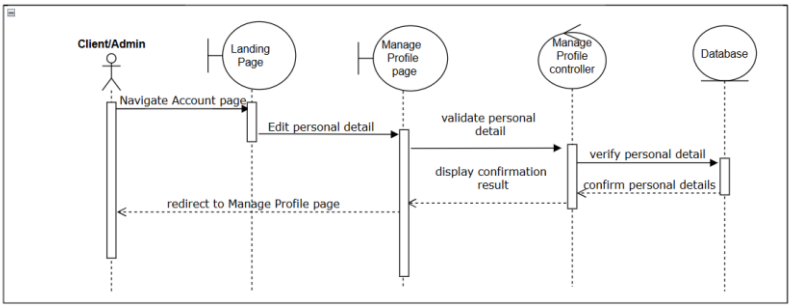


B.6: Activity Diagram for Manage Product

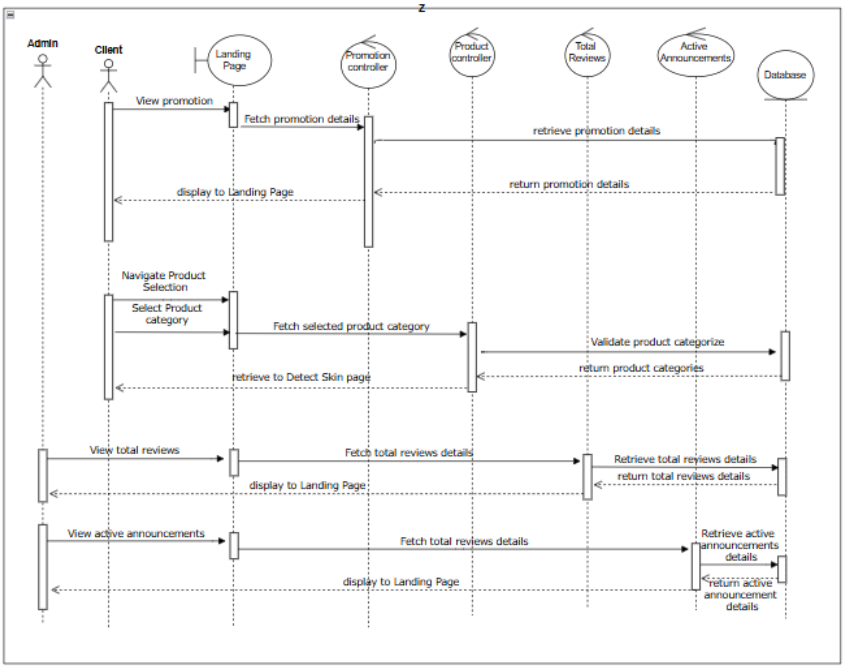
Appendix C: Sequence Diagram



C.1 Sequence Diagram for Register and Login



C.2 Sequence Diagram for Manage Profile



C.3 Sequence Diagram for Landing Page

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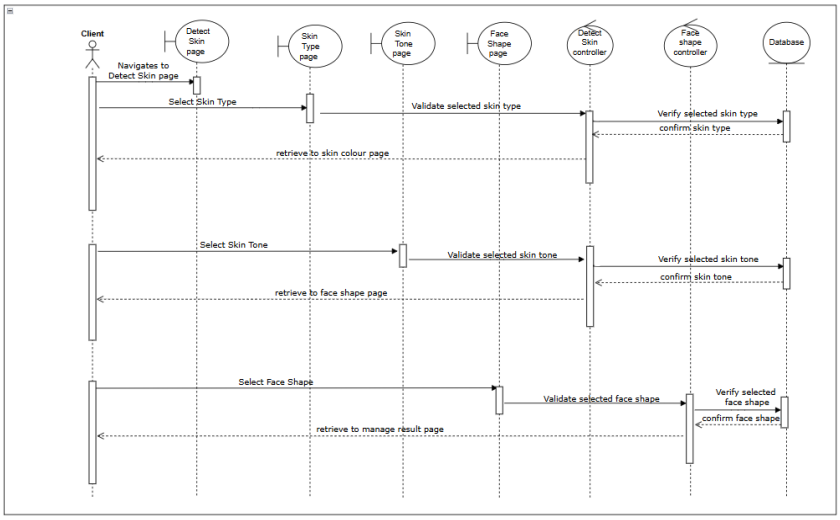
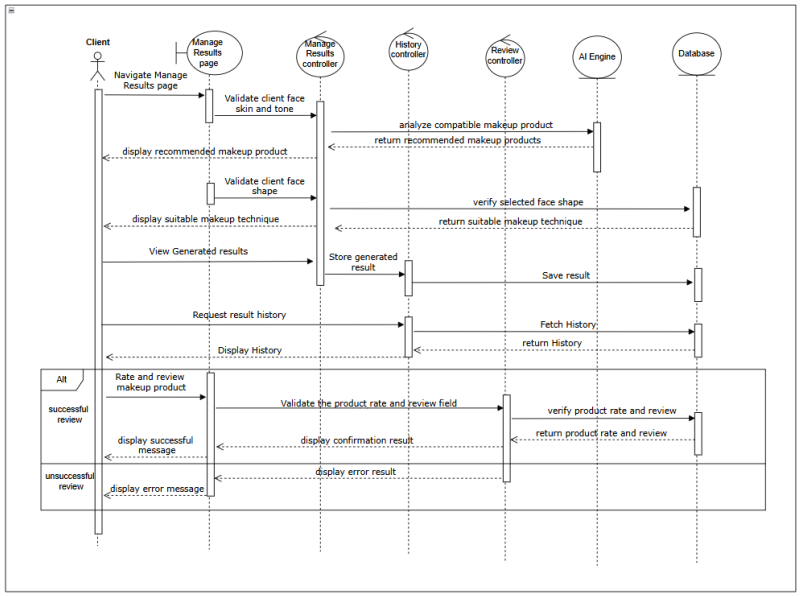
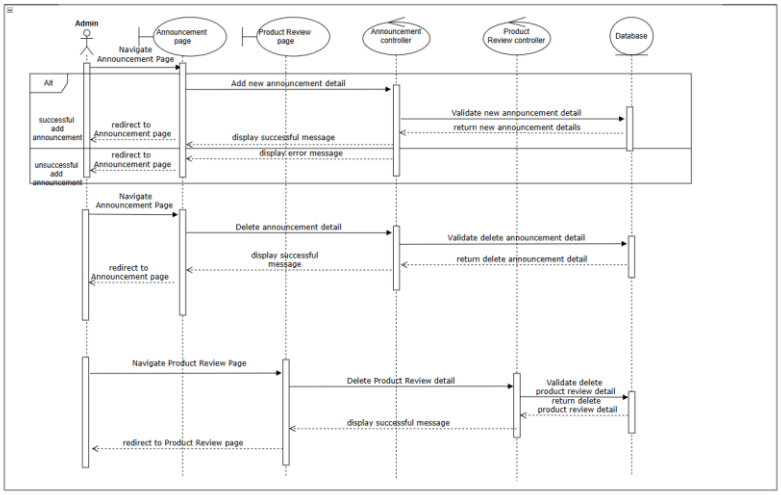


C.4 Sequence Diagram for Detect Skin



C.5 Sequence Diagram for Manage Result



C.6 Sequence Diagram for Manage Product