Chapter 3

Result and Discussion

3.1 Features

Our Flutter-based e-commerce software offers numerous major features that improve user experience and facilitate management. Splash Screen, Onetime On-boarding Screens, Authentication, Admin Panel, Shop, and Personalization are among the available features.

3.2 App Icon

The app has an icon and name which will appear on the user's phone screen after installation, ensuring a polished and professional impression.

The app icon and name ensure a consistent and branded experience from the outset. This upgrade not only improves the app's visual appeal, but it also promotes our brand identity whenever users interact with their smartphones. The app icon and app name are part of our commitment to providing a high-quality and engaging user experience.

Figure 3.1: App Icon

Moreover, the app icon and name are integral parts of our commitment to delivering a high-quality and engaging user experience. The visual elements are crafted to be both aesthetically pleasing and easily recognizable, making it simple for users to locate and launch the app. This attention to detail in the design of the app icon and name underscores our dedication to excellence and user satisfaction.

By prioritizing a consistent and attractive visual presentation, we ensure that our app stands out in a crowded marketplace. The branded icon and name not only capture users' attention but also convey a sense of reliability and professionalism. These enhancements contribute to a seamless and enjoyable user experience, encouraging users to engage with the app regularly.

3.3 Native Splash Screen

We added a native splash screen to our Flutter app to improve the user experience when it first starts up. The splash screen shows app logo while the app launches, ensuring that users receive a pleasant and branded screen rather than a blank or unresponsive one. Several key initializations occur during this procedure. The app framework is initialized, local storage is configured, and Firebase services are started to handle authentication and other backend activities.

Throughout these setup processes, the splash screen remains visible, giving the user with a smooth experience. When all initializations are finished, the splash screen is removed and users are directed to the appropriate screen. This smooth transition improves the app's perceived performance and prevents users from seeing an empty or unresponsive screen throughout the launch process.

Figure 3.2: Native Splash Screen

3.4 On-Boarding Screen

The On-boarding Screen appears when the user first launches the app. This on-boarding process includes three pages that introduce the user to the app's features. When the user reaches the third on-boarding screen, these screens will disappear and be replaced by a wonderfully designed home page. Furthermore, the on-boarding screens are compatible with both light and dark themes and adjust to the device's settings.
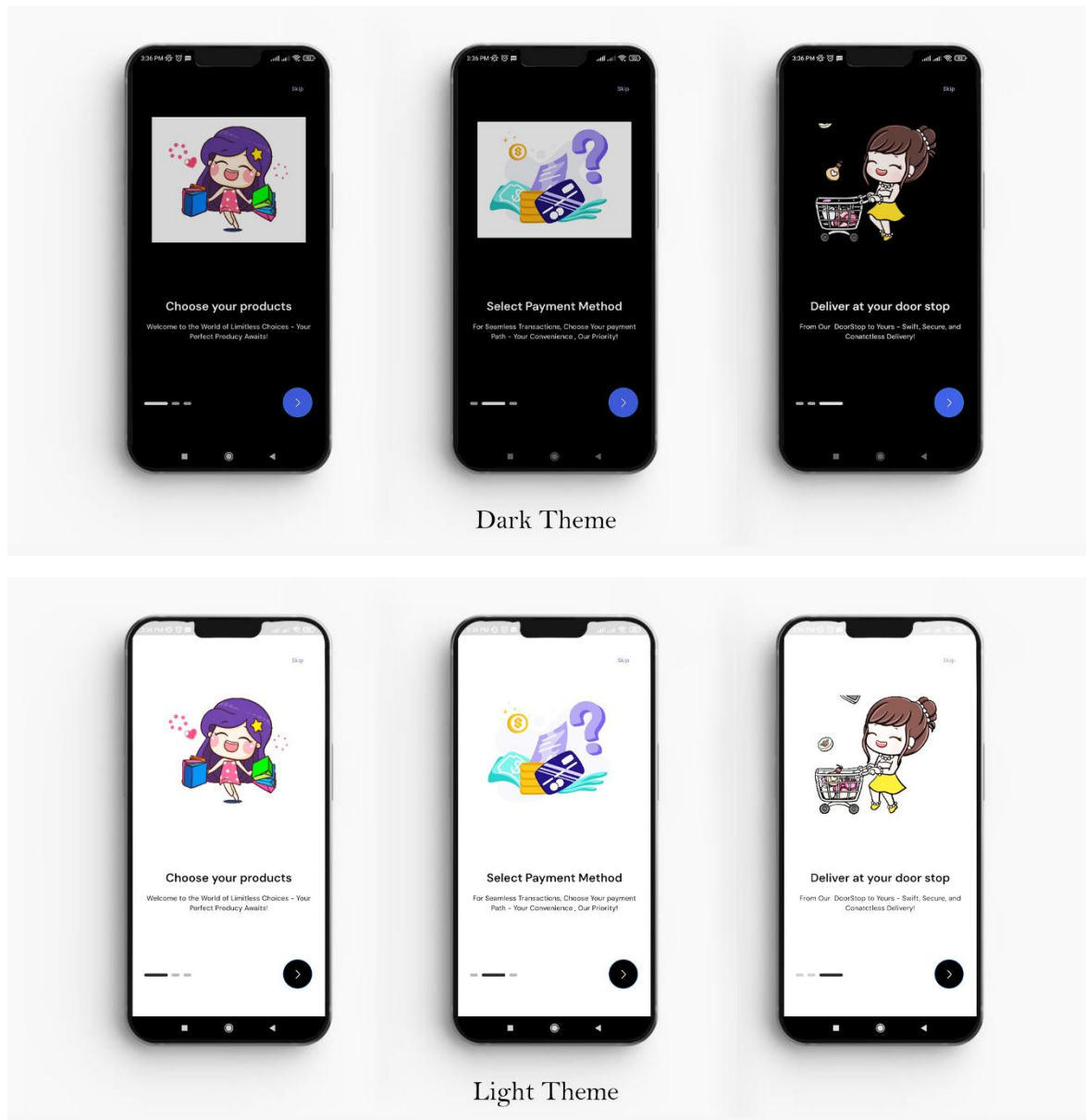

Figure 3.3: On-Boarding Screen

3.5 Login Screen

Our Flutter-based e-commerce application's authentication mechanism is both powerful and user-friendly. The login page, which uses Firebase authentication, guarantees that users have secure access. Using GetX for state management, the app uses "**obs**" type variables to detect changes and eliminate unnecessary widget re-rendering, resulting in improved performance.

The login screen itself is smartly created, with a simple and appealing appearance. It offers a "Remember Me" feature that saves user credentials to local storage for convenience. In addition, users can reset their passwords using the "Forgot Password" option. After entering their email address, users are taken to a screen that confirms that a password reset link has been delivered to their email. If the user does not receive the email, they can resend the password reset link at a predetermined time interval. Which allows them to safely reset their password by email.
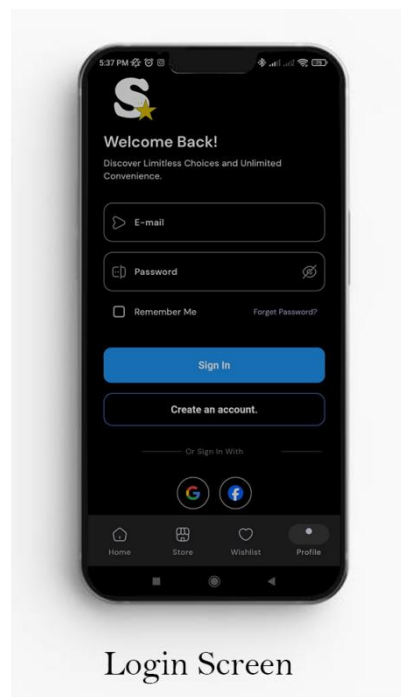

Figure 3.4: Login Screen

Additionally supported by Google Sign-In, our application aims to improve user ease. By allowing users to log in using their Google account, this functionality considerably streamlines the authentication procedure. Those who utilize Google Sign-In can benefit from a quicker, more effective login process by not having to remember several passwords. Through the use of Google's strong authentication procedures, this integration not only makes the login process simpler but also improves security.

Overall, the authentication process is streamlined and secure, resulting in a seamless and efficient user experience from initial setup to daily login operations.

3.6 Sign-up Screen

The sign-up screen of our Flutter-based e-commerce application is intended to make account creation as simple and secure as possible for users. It includes robust form validation to improve both the user experience and data integrity.

Users must enter their first and last names, username, email address, phone number, and password. The form has strong validation checks: all fields must be completed before proceeding, the phone number must be exactly 11 digits, and the password must fulfil certain strength standards. In addition, users must agree to the privacy policy by checking the box; otherwise, account creation will not proceed.
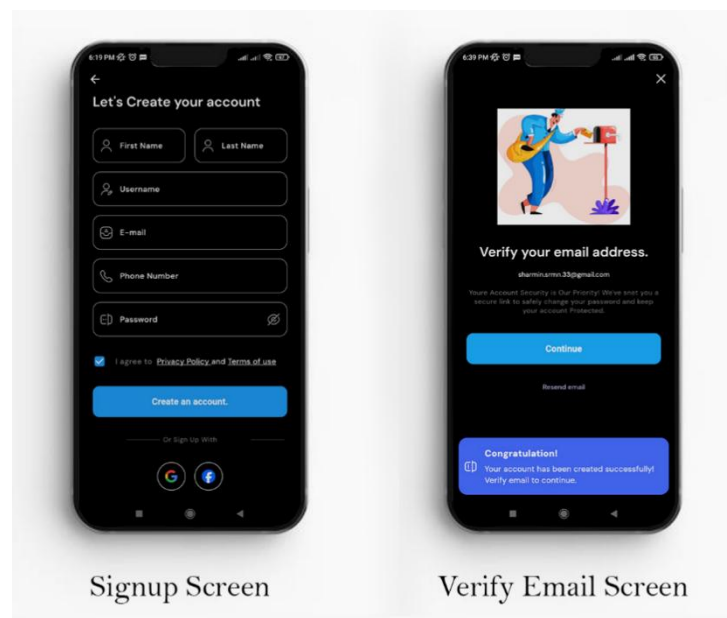

Figure 3.5: Sign-up Screen

Once all of the information has been successfully entered, an email verification link is delivered to the user's email address. The account creation process is completed only after the user confirms their email address by clicking the link. This two-step verification ensures that only authentic email addresses are used for account registration, hence increasing security.

To improve performance, the app use GetX for state management. This method ensures that only the essential widgets are re-rendered when changes occur, reducing wasteful rendering and enhancing app responsiveness and efficiency.

3.7 Home Screen

The main page of our Flutter-based e-commerce app consists of several elements, including the app bar, search bar, slider or banner images, new arrivals section, men's section, and women's section. Additionally, our home page features a refresh indicator; when users pull down the screen, they will see a nice refresh animation, and the whole page will be reloaded, ensuring they have the most up-to-date content.
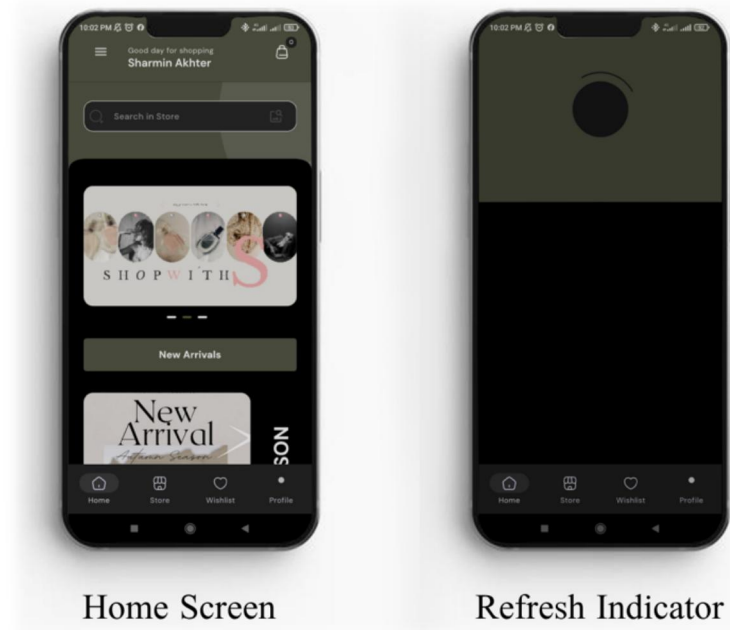

Figure 3.6: Home screen

3.7.1 App Bar

The home page of our Flutter-based e-commerce app is intended to create a welcome and intuitive user experience. At the top, a default welcome text welcomes all users, which dynamically refreshes to reflect the user's name as they logged in. A cart icon, neatly placed next to the welcome message, redirects users to the cart page. However, only logged-in users can access the cart; if a user is not logged in, they are prompted to do login first.

The top-left corner contains a hamburger icon that, when clicked, opens a side drawer. This drawer lists all of the possible categories. Users can click on a specific category to be taken to a page displaying products from that category, as well as sort products using the sorting options provided. If there are no products available in a specific category, the user is notified. This intelligent design provides a fluid and personalized shopping experience, leading users through the app's features and product selections.

Drawer

Figure 3.7: App Bar

3.7.2 Search Bar

Our e-commerce app's search box allows users to search for products using text or images. When a user writes a text and then closes the keyboard, a circular loader displays, suggesting that the app is retrieving relevant products. Once the search is complete, the products that match the searched text are presented on our All Products page, which also includes sorting options.
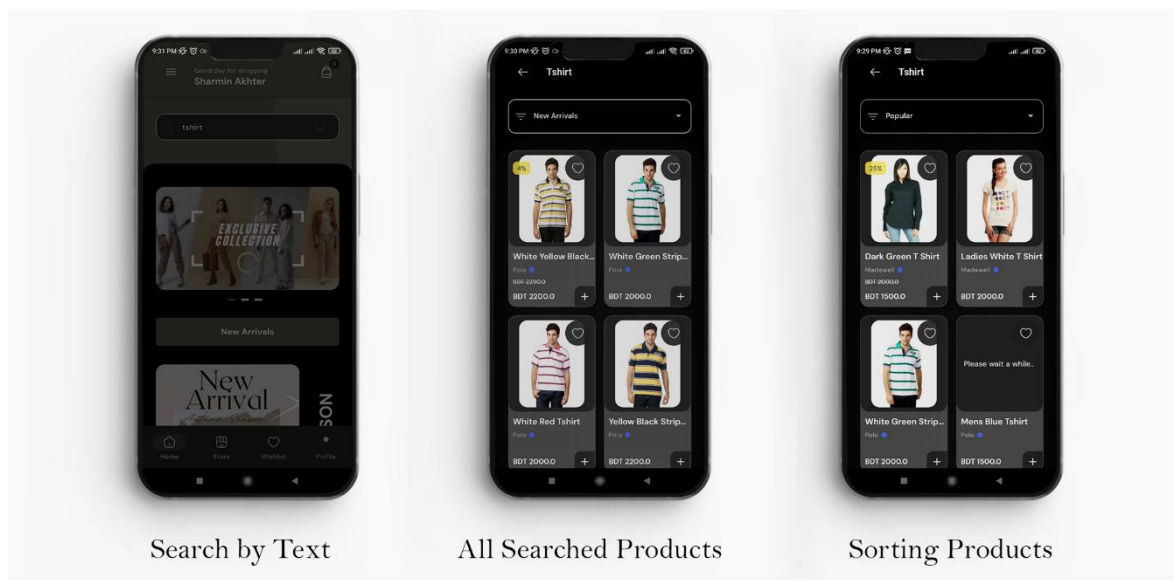

Search by Text   All Searched Products   Sorting Products

Figure 3.8: Search Bar

We have designed the All Products page to be highly reusable, serving multiple purposes such as displaying search results or showing products from specific categories. This efficient design improves the user experience and ensures consistency throughout the app.

3.7.3 Search Product Using Machine Learning

Our standout feature is the image search. Users can search for products by uploading images from their camera or gallery. After submitting the image, it is routed to our server, where a machine learning model extracts features and determines the closest matches. The app then navigates the user to the All Products page. If an exact match is found, the corresponding product is prominently displayed at the top. If an exact match is not identified, the app tries
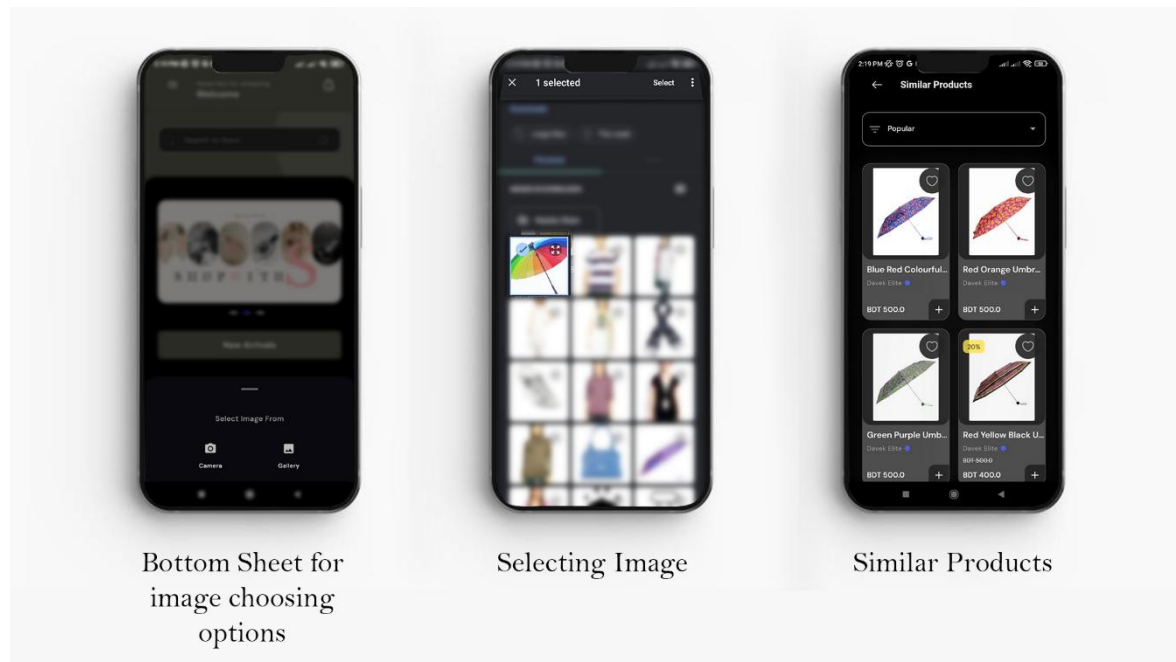

Figure 3.9: Search Product Using Machine Learning

to presents similar products to the provided image. This feature improves the shopping experience by utilizing powerful picture recognition technology, hence increasing customer convenience and happiness.

3.7.4 Slider

Our Flutter e-commerce app features a visually appealing auto-sliding image slider on the main screen. This slider providing a dynamic and engaging visual experience for users.

The pictures transition at predetermined intervals, showcasing various promotions, featured products, and key news. For further control, users can manually swipe through the photographs. This slider not only improves the app's aesthetics, but it also works well for showcasing key material and increasing user interaction.

3.7.5 New Arrival Section

The New Arrivals section of our e-commerce app is designed to highlight the most recent products that have just arrived in our shop, making it easy for customers to find the newest things. In this section, only the four most recently added products are displayed, chosen based on upload time to highlight the most recent additions. Next to these products, we have a **"View All"** text button, which, when pressed, takes customers to a thorough list of all new arrival products. This functionality is powered by a backend system that constantly refreshes the product list, identifying newly added products with a time-stamp. The front-end then retrieves this information, arranges the products according to their upload time, and shows the top four.
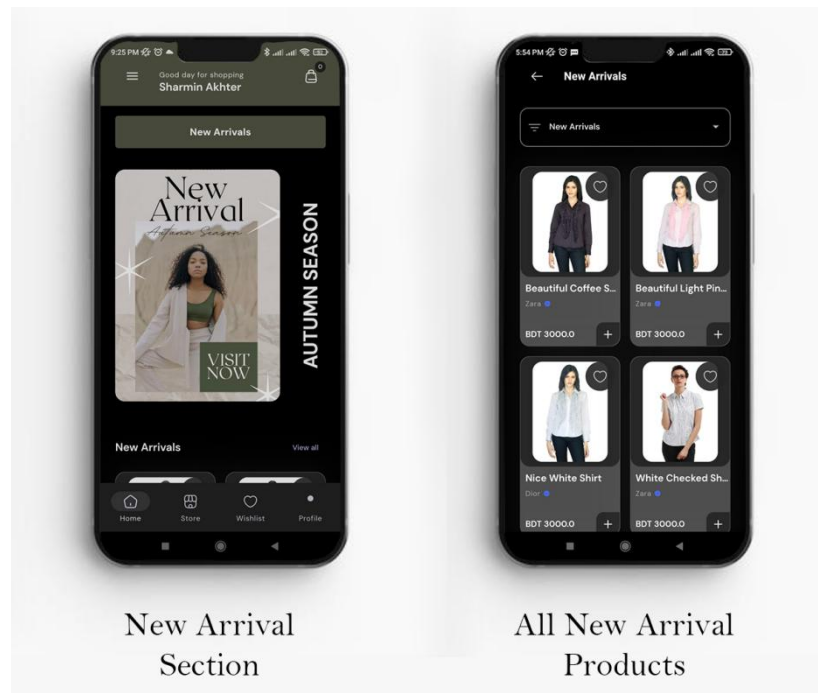

Figure 3.10: New Arrival Section

To improve the user experience, a wonderfully developed shimmer effect is displayed while retrieving data from the database. This visual signal alerts users that the material is loading, which improves perceived performance and user engagement. Furthermore, a variety of exceptions are handled to ensure a consistent user experience. For example, if there are fewer than four new products, the section adapts without disrupting the structure.

Furthermore, network problems or data fetching challenges are handled graciously, guaranteeing that the section either displays a meaningful notice or retries to retrieve the data. By focusing on the most recent arrivals and making it easy for visitors to explore further, the New Arrivals section keeps the purchasing experience new and interesting, while thorough handling of any concerns assures dependability and robustness.

3.7.6 Men's and Women's Collection Section

Our e-commerce app has a Men's Collection section beneath the New Arrivals section, which presents four randomly selected men's products. This method creates a sense of surprise and variation for customers who browse our app. A "View All" button is displayed next to these randomly selected products. When customers click this button, they are taken to a screen that displays a complete list of all the men's products available in our store.

On this all-products page, users can sort the products to improve their buying experience. They can sort things based on a variety of factors, including higher price, lower price, sale items, and new arrivals. This sorting feature allows users to customize their browsing experience based on their preferences, making it easier to locate exactly what they're looking for.

Similarly, the Women's Collection section functions in the same way as the Men's Collection. This section features four women's products chosen at random to provide variety and keep users engaged. The "View All" button in this section takes customers to a screen that includes all women's products. They can also sort the products by higher price, cheaper price, sale items, and new arrivals.

Importantly, our app uses a single screen to display all products for any given category or phrase, resulting in a uniform and streamlined user experience. Whether users are browsing new arrivals, men's collections, or any other category, they will be greeted by a familiar interface that is both straightforward and efficient.

3.8 Store Screen

The Store Screen in our e-commerce app is intended to provide consumers with a comprehensive shopping experience that includes a variety of features and functionalities. Only logged-in users can view the cart page, as indicated by the cart icon at the top of the screen. If a user who is not logged in attempts to access the cart, they will be prompted to log in, ensuring secure and personalized access to their shopping cart.
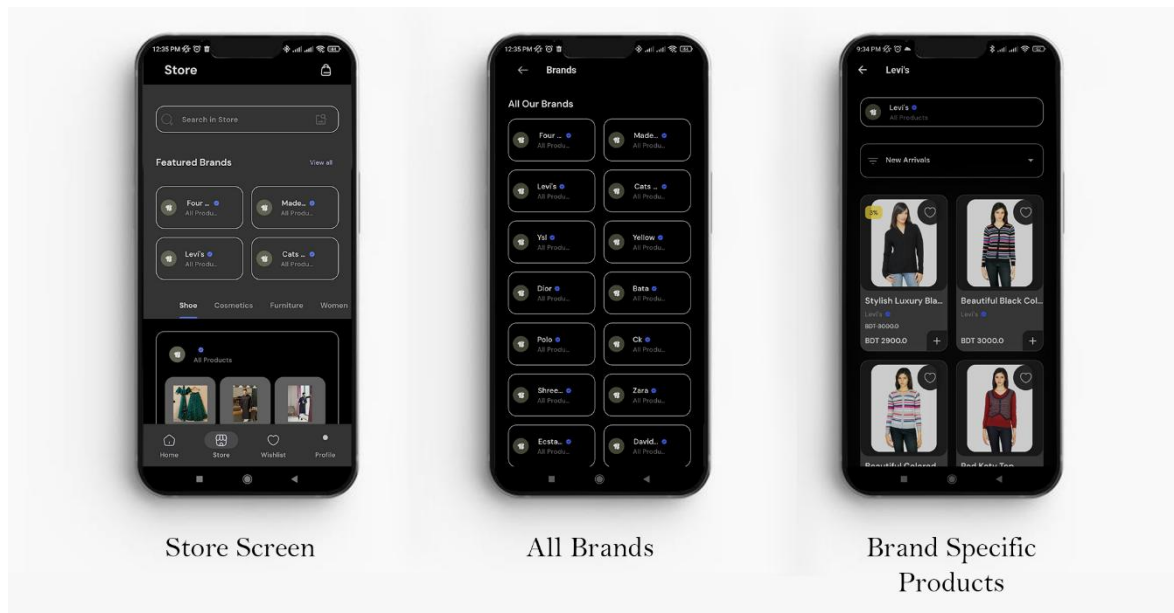
Figure 3.11: Store Screen

We have incorporated the same adaptable search bar beneath the cart icon, which supports both text and image searches for products using advanced machine learning algorithms. This tool enables customers to find products quickly and effectively by entering a search query or uploading an image.

Further down, the screen displays four random brands to provide a diverse selection and promote brand exploration. When a user clicks on a particular brand, they are taken to a screen that displays all products linked with that brand. This brand-specific product page has a sorting feature that allows users to organize things by higher price, lower price, sale items, and new arrivals. The brand name appears prominently at the top of this page, indicating to the viewer that they are examining all available products for that specific brand.

There is also a "View All" option for brands. When this option is selected, consumers are directed to a page that displays a list of all available brands in our store. Users can view the items of any brand on this page, using the same sorting options to improve their purchasing experience.

By incorporating these elements, the Store Screen not only makes it easier to navigate and discover products, but it also allows customers to easily explore and shop by brand. The uniform layout and functionality throughout the store improve the entire customer experience, making shopping easy and entertaining.

3.9 Wishlist Screen

Our Wishlist feature offers consumers a smooth experience for managing their favourite purchases. To use the wishlist, users must first create an account and log in. Once logged in, consumers can add items to their wishlist by clicking the love icon, which is prominently displayed on several screens, including the home screen, individual product screen and brand specific products screen also. This feature allows customers to easily keep track of the products they are interested in.
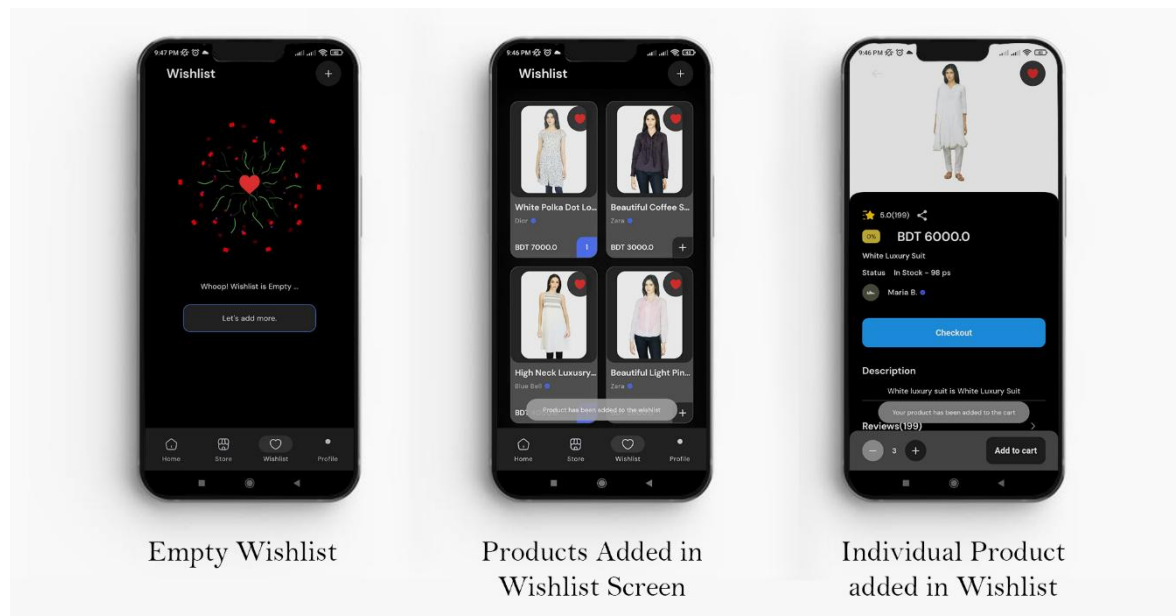

| Empty Wishlist | Products Added in Wishlist Screen | Individual Product added in Wishlist |

Figure 3.12: Wishlist Screen

If a user attempts to add a product to their wishlist while not logged in, the app will prompt them to log in first. After successfully adding a product to the wishlist, a floating toast notice appears at the bottom of the screen to confirm the activity. Similarly, removing a product from the Wishlist generates a notification, ensuring that users are always aware of changes.

If no products are added to the wishlist screen, a playful animation will appear, indicating that the wishlist is empty and encouraging users to add items. To improve the user experience, a shimmer effect is applied as the wishlist content loads, suggesting that the app is retrieving data.

The core approach for maintaining the wishlist involves saving favourite products locally. When a user logs in, their wishlist is initialized and synchronized with their previously stored preferences. The logic behind this process includes initializing the wishlist, checking login status, toggling favorite products, and saving the Wishlist state. This

ensures that the wishlist remains consistent and accessible across different screens within the app.

3.10 Individual Product Screen

In our app, we feature an individual product screen designed to display detailed information about each product. When users click on a product, they are redirected to a single product screen that showcases comprehensive details such as stock availability, price, sale price, brand name, and a detailed description of the product.
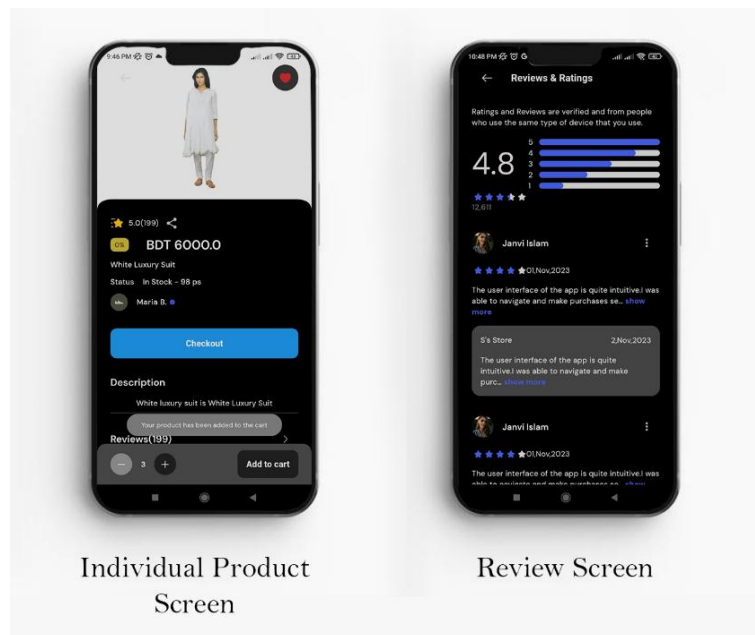

Figure 3.13: Individual Product Screen and Review Screen

There is a "Add to Cart" button at the very bottom of this page, which allows consumers to quickly add the product to their shopping cart. If the product is already in the user's wish list and cart, the screen will show the number, which indicates that number of that products is in the cart and highlight the love icon in red, indicating that it has been added to the wishlist. Users can also delete the product from their wishlist or basket from this screen, which will be confirmed by a floating toast notice at the bottom. Additionally, at the very bottom of the individual product screen, there is a "Review" button. This button redirects users to a review screen.

3.11 Account Setting Screen

Our app features a detailed account settings panel for logged-in users. If a person is not logged in, trying to visit this screen will take them to the login screen.

For logged-in consumers, the account settings panel provides a number of choices for managing their account and improving their purchasing experience. Users can update their personal information, add or change their address, check their cart, and view their order history. These features provide consumers complete control over their account information and shopping activity, delivering a more personalized and efficient experience.
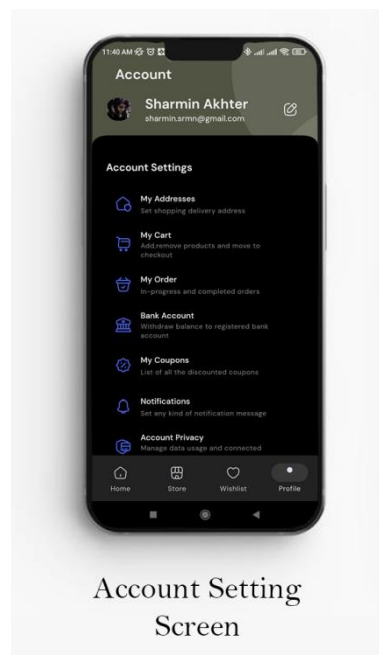

Figure 3.14: Account Setting Screen

3.11.1 Profile Setting Screen

Our app includes a dedicated profile settings screen where users may customize their account information. From this screen, users can modify their profile image, name, phone number, gender, and date of birth. To ensure account integrity and security, certain details such as email, username, and user ID cannot be changed.

Any profile adjustments will be reflected across all screens in the app, ensuring that the user's information remains consistent. We've added a delete account button to the bottom of the profile settings screen. When users select this option, a warning popup is displayed

to confirm their decision. This popup ensures that users are certain of their decision before proceeding with account deletion.

If the user confirms the deletion, the process begins by first removing all their details from the Firestore database. Following this, the user's email and password are deleted from the Firebase Authentication service, effectively terminating the account permanently.
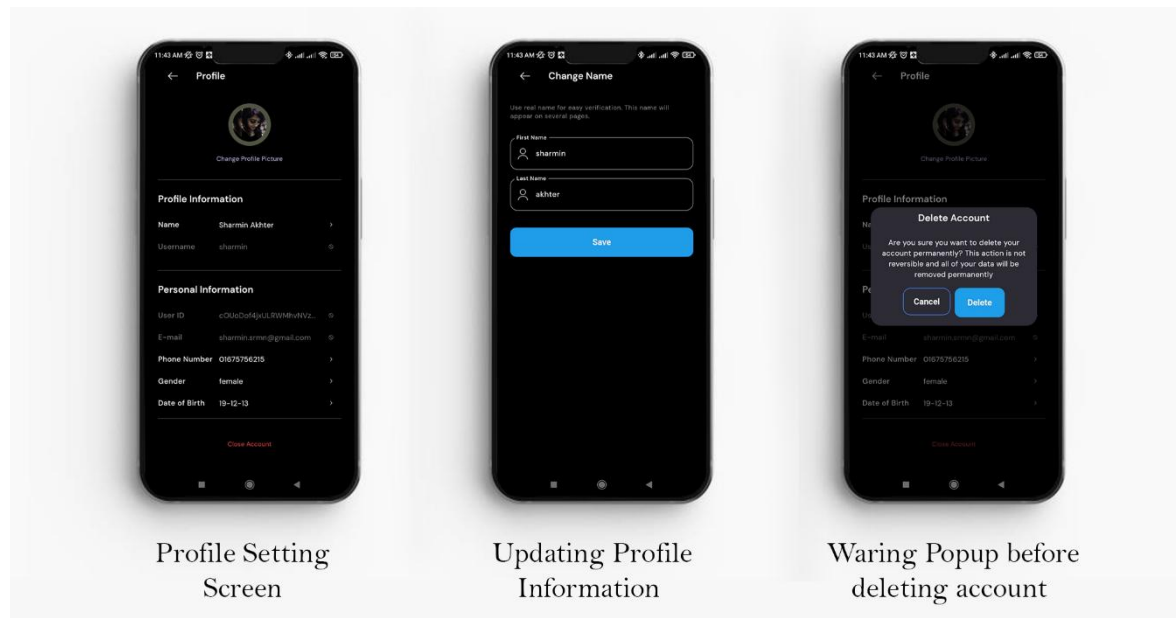

| Profile Setting Screen | Updating Profile Information | Waring Popup before deleting account |

Figure 3.15: Profile Setting Screen

This profile settings panel is intended to provide users more control over their personal information while keeping important account information secure and unchanged. The provision of an account deletion capability, complete with a confirmation step, gives users control over their data while protecting against inadvertent deletion.

3.11.2 Address Screen

Our app features a user-friendly address page where users may manage their saved addresses. This screen allows users to look over all of the addresses they have already added. Users can add new addresses using the "+" icon at the bottom. When pressed, a dialogue appears, asking if they want to enter an address manually or automatically.

If users wish to add an address manually, they must complete all fields themselves. Alternatively, if users choose the automatic way, the app will request permission to access the device's location data. If permission is given, the app will automatically enter as much

address information as possible using Google Geo-location services. Any information that cannot be tracked automatically will have to be entered explicitly by the user, such as their name and phone number.
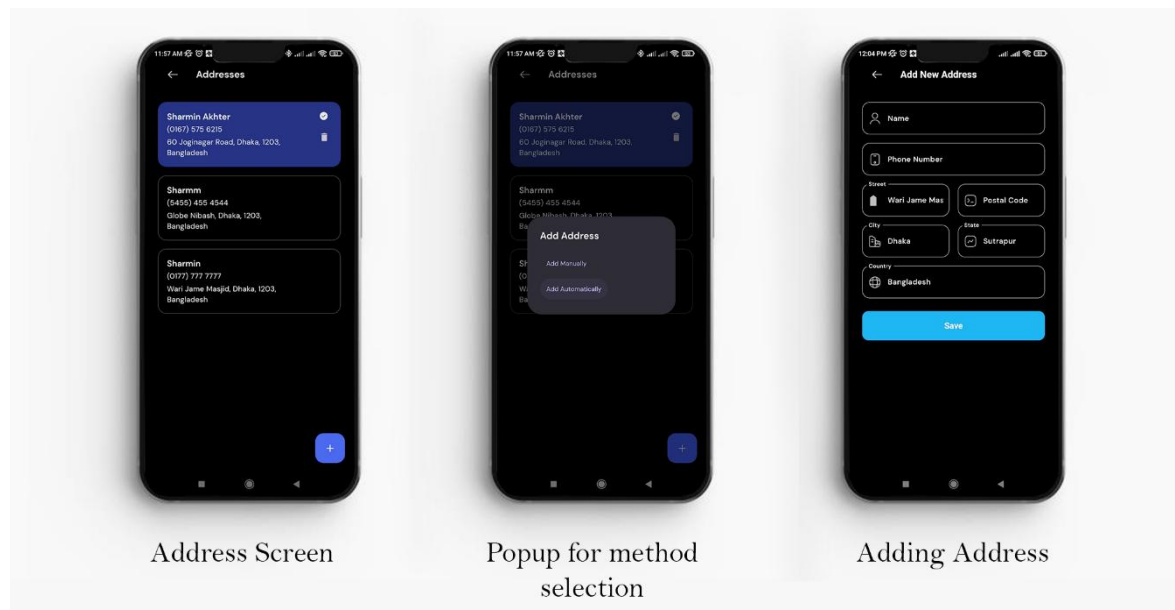

Figure 3.16: Address Screen

Users can also delete addresses if they no longer need. These newly added addresses will also be available on the order page, allowing users to place purchases to the specified address. This results in a smooth and speedy checkout process.

3.11.3 Cart Screen

Our app features a cart screen, accessible only to logged-in users, where they can view the products, they have added to their cart. On this page, users can adjust the quantity of each product using the plus and minus icons. If a user tries to remove a product when there is only one unit in the cart, a warning popup appears, asking for confirmation to ensure they really want to remove that product. If there are multiple units of a specific product, the quantity can be decreased incrementally. However, once the quantity reaches one, any further attempt to decrease it will trigger the same confirmation popup.

Users can find a checkout button at the bottom of the cart page, next to the total bill amount. This total bill updates dynamically anytime a product is added or withdrawn, giving users real-time information about their current total bill. This feature is implemented easily and quickly using the GetX state management library.
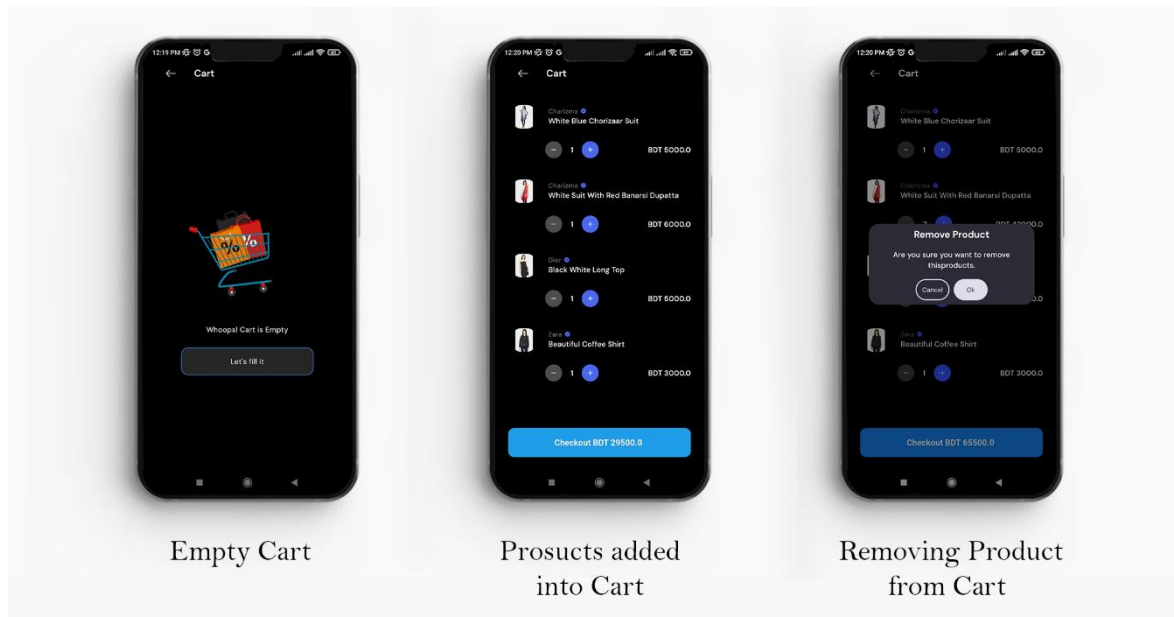
Figure 3.17: Cart Screen

Once consumers are satisfied with their cart and total bill, they can click the checkout button, which takes them to the order review page. This seamless flow guarantees that users can quickly manage their cart and proceed to checkout with minimal trouble, hence improving their buying experience.

3.11.4 Order Review and Details Screen

Our app offers an order review screen where customers can look over the things they intend to purchase. On this page, consumers may view the total amount as well as the shipping costs. If customers need to make adjustments, they can use the back button to return to the cart screen and edit their cart accordingly.

The order screen also allows customers to choose from previously added addresses or add a new one if necessary. This guarantees that the delivery details are correct and up to date.

Once everything has been confirmed, customers can click the checkout button. A confirmation screen will appear, indicating that the payment was properly processed. After that, the cart will be cleared, and users can continue shopping if they wish.
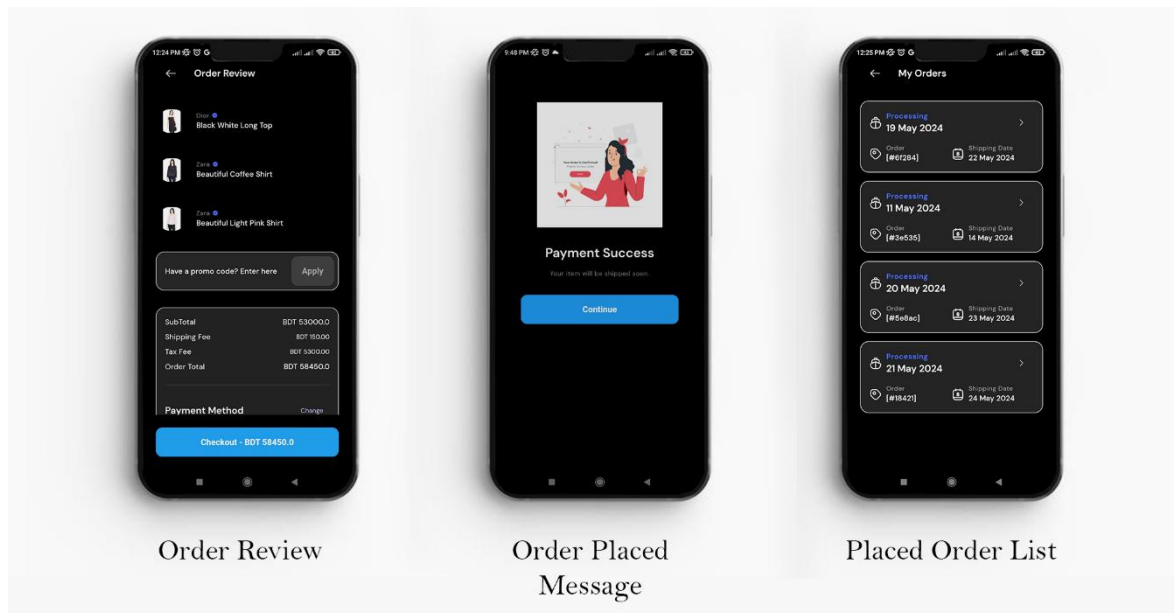
Figure 3.18: Order Review and Details Screen

After placing an order, customers can access their order history on the order screen. This section contains extensive information about each order, such as the order date, shipment date, and current processing status. This thorough order review and history feature improves the user experience by offering clear and easily accessible information about their purchases and deliveries.

3.12 Administration

Our app includes a "Load Data" option in the account settings page that is only accessible to users with an admin role. This feature is provided by providing certain roles to users. When a user has administrative privileges, they can view the load data screen, which leads to the admin dashboard.

The admin dashboard provides multiple choices for managing different components of the app. Administrators can update and manage banner pictures, handle categories, and do product management activities. These administration tools keep the app's information fresh and organized, ensuring a consistent experience for all users.

3.12.1 Category Details

Our app provides a category screen with options for adding new categories and viewing all categories that have been posted to the store. Whenever a new category is introduced, the GetX controller's reactive obs feature updates the category list throughout the UI in real time. Admins can view all categories and alter their names and images.
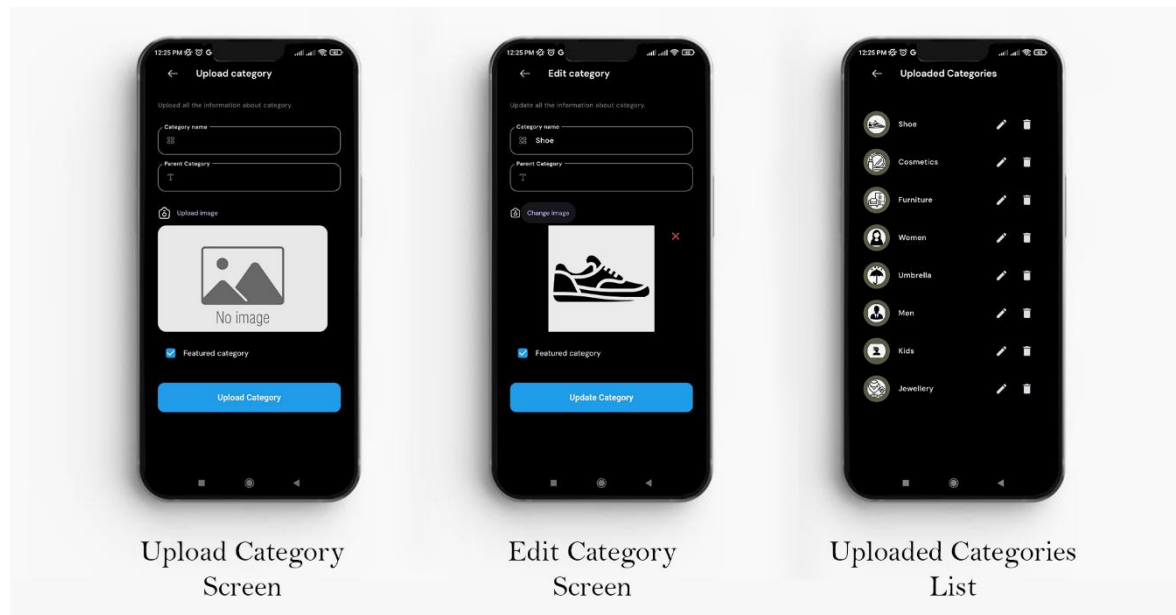

Figure 3.19: Category Details

If an administrator wants a category to be prominently shown throughout the app, they can use the "featured category" option. To conceal a category from users, simply deselect the "featured category" option. The category will be erased from user view, but it will remain available to the administrator on the all-categories page.

Administrators also have the authority to delete categories. When admin press the delete icon, a warning popup box opens to confirm the deletion. If verified, the category's image will be deleted first from Firebase Storage (if any exists), followed by all category-related information from the Firestore database. We've developed strong error handling to handle a variety of situations, such as when an image is null.

Overall, we successfully incorporated CRUD operations, allowing administrators to efficiently manage categories while keeping the app up to date and user-friendly.

3.12.2 Banner Details

Similarly, our app has a banner management tool with separate windows for adding banners and viewing all banners. Admins can upload new banner images and determine

whether they will appear on the homepage by clicking the "Active" button. If selected, the banner will appear on the home page immediately after uploading. If not, the banner will not appear on the home screen but will be visible to the administrator on the all-banners panel.
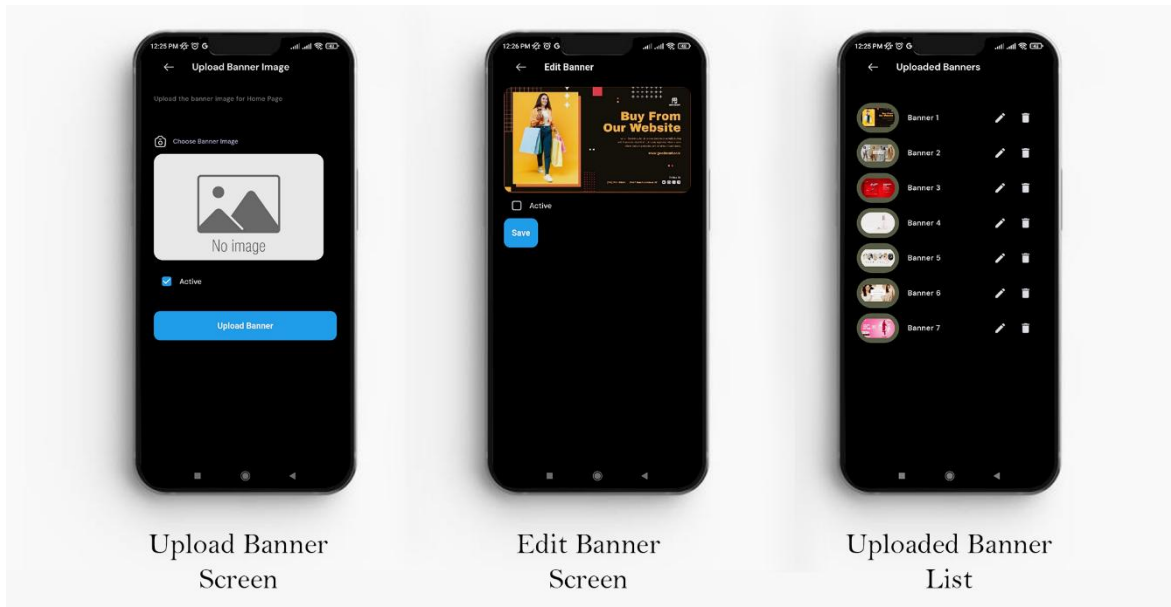

Figure 3.20: Banner Details

Admins can modify banners from the all-banners screen, and toggle the active state to determine whether they should be displayed on the home page. Admins have the ability to permanently delete banner images. Before deleting the banner, a confirmation box will display, asking the administrator if they actually want to delete it.

This configuration ensures that managers may efficiently manage banner visibility while maintaining a dynamic and entertaining home page.

3.12.3 Product Details

Our app features a robust product management screen for admins, which includes two sub-screens: one for adding products and another for viewing all uploaded products.

On the add product screen, to add a new product, administrators must fill out all of the forms and upload an image. When a product is uploaded it is immediately available in the new arrivals area of our home page. We have incorporated extensive validation checks for all fields, ensuring that no product can be uploaded without all required information. If

any fields are left blank, a warning message will appear to notify the administrator. Once all validations are completed successfully, the product will be uploaded.
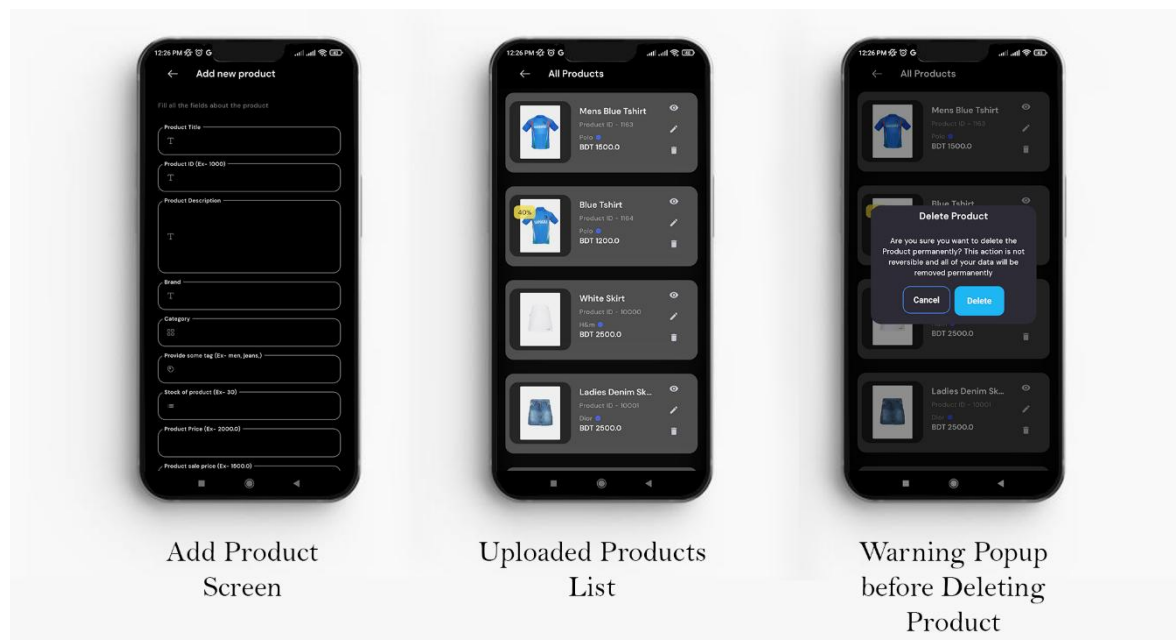

Figure 3.21: Product Details

The all-products screen displays all uploaded products, sorted by product ID. Admins can see, edit, and delete items from this screen. Admins can examine product details by clicking on the eye icon. The edit icon allows them to change product details, while the delete icon removes products from anywhere in the application.

Before deleting a product, a warning popup will show to confirm the action. If confirmed, the product image will be deleted first from Firebase Storage, then the product details from the Firestore database. We have successfully implemented CRUD processes, resulting in the seamless and efficient management of product data.

3.12.4 Log Out

In our app, users have the option to log out from their account. Once logged out, they will no longer have access to the Account Settings Screen, Cart Screen, or Wishlist screen. If they had previously chosen the "Remember Me" option, they can easily log back in using that feature. Without logging in, their name on the home page will be replaced with the text "Welcome." If they attempt to access the Account Settings Screen, Cart Screen, or Wishlist screen, they will be prompted to log in first. This ensures that user data and preferences are secure and accessible only when authenticated.

3.13 Server

Our server that handles user-uploaded photos. The server is created with Flask, a Python web framework, and includes a specific subdirectory for saving uploaded images. It uses pre-loaded data to compare and identify comparable photos. When the server starts, it loads essential files to help in the search for similar photos and configures a machine learning model to process these images.

When a user uploads an image, the server first checks whether an image file is included in the request. If an image is present, it is stored to a predefined folder on the server. The server then scans the saved image and applies the machine learning model to extract specific features from it. These characteristics assist in identifying the image.
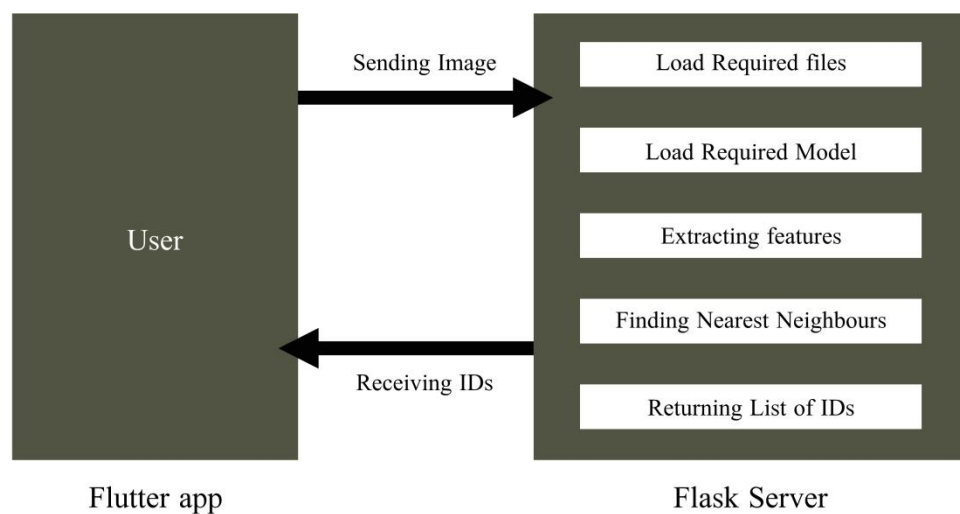

Figure 3.22: Server

Using a mechanism known as Nearest Neighbors, the server then compares these features to those of other images in its **pkl** file to find the most similar ones. Finally, the server responds to the user, confirming that the image was successfully uploaded and offering a list of product id of related photos. If any issues occur, such as no image being uploaded or selected, the server displays an appropriate error message.

3.14 Creating pkl file

To create pkl files, we define a procedure for analyzing images and saving relevant information about them for later use. First, we load a pre-trained model, which is an

advanced programmed that understands how to analyses images. We then prepare this model to work with our specific images.

To obtain the distinctive features of each image, we read it, process it, and extract the special details that help in identification. We then save these facts in a list. This step is done for each image in a given folder.

Finally, we store the extracted details, image names, and unique IDs to separate files. These files will allow us to easily compare fresh images to previously saved ones in order to identify similarities in the future. This approach allows us to organize and easily search through a vast collection of images.

3.15 Social Impact and Growth in E-Commerce:

The social impact of e-commerce is often measured by satisfaction and trust through the subsequent factors:

- Increased usage of the internet: Youth and students make up the fastest-growing demographic category.

- This market group is the top user of internet technology and sophisticated applications.

- As per a poll carried out by the Web and Mobile Association of India, there were 190 million Internet users in the nation as of June 2013.

- As more people use phones to access the internet, it was anticipated that the number of users in the nation would reach 243 million in June 2014, a 28% increase from the previous year.

- The rise in Internet users has also contributed significantly to the expansion of other digital businesses, such as digital advertising, mobile commerce, and e-commerce.

- The Indian government has worked to improve the educational system by introducing computer tools and procedures that are necessary for all educational levels, from basic school to graduate school.

- By providing private computers, laptops, tablets, or laptops with the web and its benefits to improve lifestyle and offer electronic books and e-books, students from both urban and rural locations were made more aware of the issues.

- The application of cutting-edge computer technologies to internet commerce is another area of interest for entrepreneurs.

- The market's strong demand for m- and electronic-commerce has been made possible by the establishment of educational standards at the lowest possible levels.

- Modifications in online buying behaviors The online shopping procedure is continuously being improved to make it simpler, easier to use, and more comprehensible

- Because internet deals offer enticing pricing and some savings.

- This has changed internet shoppers' purchasing behavior coupled with greater deals.

3.16 The Environmental Impact of E-Commerce

Online shopping is convenient, but it has a substantial negative impact on the environment, mostly from packing waste. A significant amount of packaging trash, including cardboard, plastic, and bubble wrap—which are frequently challenging to recycle is produced by e-commerce. According to the World Economic Forum, e-commerce packaging handles 165 billion parcels a year, and that number is rising. Online shopping also increases the usage of single-use items, increases electronic waste, and transportation-related carbon emissions. For instance, in 2019 alone, Amazon produced 465 million pounds of garbage from plastic packaging. Just 14% of plastic packaging is collected worldwide for recycling, meaning that a large portion of this garbage is not recycled. Customers can choose products with minimum or environmentally friendly packaging and take part in recycling initiatives to lessen these consequences. Businesses can also enhance their shipping procedures and use environmentally friendly packaging materials. We can lessen the environmental effect of internet shopping and save the earth for future generations by implementing these improvements.

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