E-COMMERCE MOBILE APPLICATION

A

MAJOR PROJECT-II REPORT

Submitted in partial fulfillment of the requirements

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BACHELOR OF TECHNOLOGY

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By

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CERTIFICATE

We here by certify that the work which is being presented in the B.Tech. Major Project-II Report entitled **E-COMMERCE MOBILE APPLICATION**, in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology, submitted to the Department of **Computer Science & Engineering**, Sagar Institute of Science & Technology (SISTec), Bhopal (M.P.) is an authentic record of our own work carried out during the period from Jan-2025 to June 2025 under the supervision of **Dr. Komal Tahiliani.**

The content presented in this project has not been submitted by me for the award of any other degree elsewhere.

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ABSTRACT

This project focuses on creating an E-Commerce Mobile Application to provide users with a seamless and efficient shopping experience. Traditional e-commerce platforms often face issues such as slow performance, security vulnerabilities, and lack of cross-platform support. This system aims to address these challenges by integrating Flutter for the frontend, Spring Boot for the backend, PostgreSQL for database management, and Aiven Cloud for scalable and secure hosting.

The system allows users to browse products, add items to their cart, and complete purchases through a secure payment gateway. It also includes an admin panel to manage product listings, orders, and user accounts. The app provides real-time updates and notifications, ensuring users stay informed about their orders and any ongoing offers. The goal is to improve the overall online shopping experience by offering fast load times, an intuitive interface, and a robust backend that can handle high user traffic.

By leveraging modern cloud-based solutions, the system ensures data security, reliability, and performance. The cross-platform compatibility of Flutter allows the application to run smoothly on both Android and iOS devices. This project demonstrates how cutting-edge technologies can be used to develop a scalable and efficient e-commerce solution, helping businesses grow and users shop conveniently from anywhere.

LIST OF ABBREVIATIONS

ACRONYM	FULLFORM
SDLC	Software Development Life Cycle
SQL	Structured Query Language
API	Application Programming Interface
UI/UX	User Interface / User Experience
IDE	Integrated Development Environment
MVC	Model-View-Controller
HTTPS	Hypertext Transfer Protocol Secure
DBMS	Database Management System

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CHAPTER 1
INTRODUCTION

1.1 ABOUT PROJECT

This document outlines the vision and core features of a modern and efficient E-Commerce Mobile Application designed to revolutionize the online shopping experience. Leveraging a robust and contemporary technology stack, including Flutter for a dynamic and cross-platform user interface, Spring Boot for a scalable and secure backend, PostgreSQL for reliable and efficient data persistence, and Aiven Cloud for a fully managed and highly available cloud infrastructure, this application aims to provide a seamless, secure, and real-time online shopping platform.

Unlike conventional e-commerce solutions prevalent in the market, which often struggle with issues such as slow loading times, limited ability to handle fluctuating user loads, and potential security vulnerabilities, our application is engineered to offer a highly scalable, remarkably fast, and rigorously secure alternative. The application's core functionality centers around a user-friendly UI/UX, ensuring customers can effortlessly navigate and interact with the platform to browse an extensive product catalog featuring detailed information and high-quality visuals.

Key features include an intuitive shopping cart system, a streamlined and secure checkout process integrating multiple trusted payment gateways relevant to users in Bhopal, Madhya Pradesh, India, and globally, and comprehensive real-time order tracking capabilities with timely notifications. The backend, powered by the enterprise-grade capabilities of Spring Boot and the reliability of PostgreSQL, guarantees efficient management of product data, user information, and transaction records, while the strategic integration of Aiven Cloud provides a resilient and scalable infrastructure, ensuring high availability and optimal performance even during peak demand.

1.2 PROJECT OBJECTIVES

1.2.1 User Authentication:

The application will implement a robust and secure user authentication system to protect user accounts and sensitive data. This will encompass:

- **Secure Login:** Existing users will be able to securely log in to their accounts using their registered email address or phone number and a corresponding password. The login process will employ industry-standard security protocols to prevent unauthorized access.

- **User Registration:** New users will be provided with a straightforward and intuitive registration process. They will be able to create new accounts by providing necessary details such as their name, email address or phone number, and a strong, unique password. Password complexity requirements will be enforced to enhance security.

- **JWT Authentication:** JSON Web Tokens (JWT) will be utilized as the primary authentication mechanism. Upon successful login, the backend server will issue a JWT to the client application. This token will then be included in subsequent requests to the server, allowing the server to verify the user's identity without requiring repeated login credentials for each request, ensuring a seamless and secure session management.

- **Account Management:** Registered users will have the ability to manage their accounts. This includes updating their profile information (e.g., name, contact details), managing their saved shipping addresses for faster checkout, and securely resetting their passwords in case they are forgotten, providing users with control over their personal information and account security.

1.2.2 Product Browsing:

The application will feature a user-friendly and intuitive interface that allows customers to easily explore and discover products available on the platform. Key aspects of product browsing include:

- **Intuitive Interface:** The application will present products in a visually appealing and well-organized manner, utilizing clear layouts, high-quality product images, and logical categorization to facilitate easy navigation.

- **Product Catalog:** Users will be able to browse through an extensive catalog of products, categorized logically to help them find items of interest quickly. Categories and subcategories will be clearly defined and easily accessible.

- **Search Functionality:** A robust and efficient search bar will be prominently placed, allowing users to search for specific products using keywords related to product names, descriptions, or categories. The search functionality will be optimized for speed and accuracy, providing relevant results quickly.

- **Filtering and Sorting:** To further refine their search and browsing experience, users will have access to various filtering and sorting options. They will be able to filter products based on criteria such as category, price range, brand, customer ratings, and other relevant attributes. Sorting options will include price (low to high, high to low), popularity, and newest arrivals, enabling users to find products that meet their specific needs and preferences.

1.2.3 Shopping Cart & Checkout:

The application will provide a seamless and secure shopping cart and checkout process to facilitate easy purchasing of selected items:

- **Add to Cart:** Users will be able to easily add desired products to their virtual shopping cart while browsing. Clear visual cues and confirmations will indicate when an item has been successfully added.

- **Cart Review:** Users will have convenient access to their shopping cart, where they can review the selected items, view quantities, see individual product prices and the subtotal, and have the option to adjust quantities or remove items as needed before proceeding to checkout.

- **Discount Application:** The checkout process will include a clear mechanism for users to apply valid discount codes or promotional offers, with the updated total reflected in real-time.

- **Secure Checkout:** The checkout process will be designed with security as a top priority. Users will be guided through clear steps to provide necessary shipping information, select their preferred delivery options (if applicable), and review their order summary before proceeding to payment. All sensitive information exchanged during the checkout process will be securely transmitted using encryption protocols.

1.2.4 Order Management (Admin Panel):

A dedicated and comprehensive admin panel will be developed to empower platform administrators with the tools necessary to efficiently manage the e-commerce operations:

- **Product Inventory Management:** Administrators will have full control over the product inventory. They will be able to track stock levels for each product, update inventory counts, manage product variations (e.g., sizes, colors), and receive alerts for low stock levels to prevent overselling and ensure adequate product availability.

- **User Order Management:** The admin panel will provide a centralized system for managing all user orders. Administrators will be able to view order details, track order statuses (e.g., pending, processing, shipped, delivered), update order statuses, and manage cancellations or returns as necessary.

- **Shipping Details Management:** Administrators will be able to manage shipping information, including integrating with shipping providers (if applicable), setting shipping rates, and tracking shipments. They will also have the ability to update shipping details for individual orders and communicate shipping information to customers.

1.2.5 Payment Integration:

The application will integrate with secure and reliable payment gateways to offer users a variety of convenient payment options:

- **UPI Integration:** Support for popular Unified Payments Interface (UPI) methods widely used in India will be implemented, allowing users to make direct payments from their bank accounts using UPI IDs or QR codes.

- **Credit/Debit Card Processing:** Integration with secure payment processors will enable users to make payments using their major credit and debit cards. Secure handling of card details will be ensured through compliance with relevant security standards (e.g., PCI-DSS).

- **Digital Wallet Support:** Integration with popular digital wallets will provide users with an additional convenient and secure payment option, allowing them to link their wallet balances to the application for quick and easy transactions.

- **Secure Payment Processing:** All payment transactions will be processed securely through encrypted channels and compliant payment gateways, ensuring the confidentiality and integrity of sensitive financial information and protecting users from fraud.

1.2.6 Real-Time Notifications:

The application will incorporate a real-time notification system to keep users informed and engaged:

- **Order Updates:** Users will receive timely push notifications on their mobile devices to keep them updated on the status of their orders, including order confirmation, shipment updates with tracking information, and delivery notifications.

- **Special Offers and Promotions:** The application will have the capability to send targeted notifications to users about exclusive offers, discounts, and promotions on products.

- **Stock Availability Alerts:** Users who have expressed interest in products that are currently out of stock will receive real-time notifications when those items become available again, ensuring they don't miss out on purchasing desired products. These notifications will enhance the overall user experience and provide valuable, timely information.

1.3 FUNCTIONALITY

The project consists of the following key components:

1.3.1 User Authentication:

The application will implement a robust and secure user authentication system to protect user accounts and sensitive data. This will encompass:

- **Secure Login:** Existing users will be able to securely log in to their personalized accounts using their registered credentials, such as email address or mobile phone number, and a confidential password. The login process will employ industry-standard encryption and security protocols to safeguard against unauthorized access and ensure the privacy of user information.

- **User Registration:** New users will be guided through a straightforward and intuitive registration process to create their accounts. This will involve providing essential details like their name, a valid email address or mobile phone number, and setting up a strong, unique password adhering to defined complexity requirements. Account creation will be designed to be quick and easy, facilitating a smooth onboarding experience for new customers in Bhopal, Madhya Pradesh, India, and beyond.

- **JWT Authentication:** To maintain secure and efficient session management, the application will utilize JSON Web Tokens (JWT). Upon successful login, the backend server will generate a JWT, which will be securely stored on the user's device. This token will then be automatically included in subsequent requests made by the mobile application to the server, allowing the server to verify the user's identity without requiring repeated submission of login credentials for each interaction, thus enhancing both security and user convenience.

- **Account Management:** Registered users will have comprehensive control over their accounts. They will be able to access and update their profile information, including personal details and contact preferences. Additionally, users can manage their saved shipping addresses, enabling faster and more convenient checkout for future purchases within Bhopal and other locations. The system will also provide a secure mechanism for users to reset their passwords if forgotten, ensuring they can regain access to their accounts while maintaining security.

1.3.2 Product Browsing:

The application will feature a user-friendly and visually appealing interface designed to facilitate effortless exploration and discovery of the diverse range of products available on the platform. Key aspects of product browsing include:

- **Intuitive Interface:** The product catalog will be presented through a clean, well-organized, and visually engaging layout, utilizing high-quality product images, clear and concise descriptions, and intuitive navigation elements. This design will ensure that users can easily browse and understand the available offerings, regardless of their technical expertise.

- **Product Catalog:** Users will be able to navigate through an extensive and systematically categorized catalog of products. Logical categorization and sub-categorization will allow users to efficiently locate items of interest based on product type, brand, or other relevant criteria. Clear visual cues and intuitive navigation menus will guide users through the different sections of the catalog.

- **Search Functionality:** A prominent and highly functional search bar will be integrated into the application, enabling users to quickly find specific products by entering relevant keywords related to product names, descriptions, categories, or brands. The search engine will be optimized for speed and accuracy, employing intelligent algorithms to provide relevant search results, even with partial or slightly misspelled queries, catering to the diverse search habits of users in Bhopal and elsewhere.

- **Filtering and Sorting:** To enhance the product discovery process, users will have access to a comprehensive suite of filtering and sorting options. They will be able to refine their search results based on various criteria such as price range, product category, brand, customer ratings, availability, and other specific attributes. Sorting options will include price (low to high, high to low), popularity, relevance, and newest arrivals, empowering users to quickly narrow down their choices and identify products that precisely match their requirements and preferences.

1.3.3 Shopping Cart & Checkout:

The application will provide a seamless, intuitive, and secure shopping cart and checkout experience, ensuring a smooth transition from product selection to purchase completion:

- **Add to Cart:** Users will be able to effortlessly add desired products to their virtual shopping cart with a single tap or click while browsing product listings or individual product pages. Clear visual feedback and confirmations will immediately indicate that the item has been successfully added to their cart, providing reassurance to the user.

- **Cart Review:** Users will have convenient and readily accessible access to their shopping cart. Within the cart interface, they can review the selected items, view detailed information such as product name, quantity, price, and any applicable variations. They will also have the ability to easily adjust the quantity of each item, remove items they no longer wish to purchase, and view a clear and updated subtotal of their selected items before proceeding to checkout.

- **Discount Application:** The checkout process will feature a dedicated and easily identifiable section where users can enter and apply valid discount codes, promotional vouchers, or loyalty rewards. Upon successful application of a discount, the order total will be automatically recalculated and clearly displayed to the user before they finalize their purchase, ensuring transparency and allowing them to see the immediate benefit of their discounts.

- **Secure Checkout:** The checkout process will be meticulously designed with security as the paramount concern. Users will be guided through a clear and concise series of steps to provide necessary shipping details, including recipient name, delivery address (relevant for locations within Bhopal, Madhya Pradesh, India, and other regions), and contact information. They will also be able to select their preferred shipping method (if multiple options are available) and review a comprehensive order summary, including all selected items, shipping costs, and the final order total, before proceeding to the secure payment stage. All sensitive information exchanged during the checkout process, including personal details and payment credentials, will be protected using robust encryption protocols (such as HTTPS) to ensure confidentiality and prevent unauthorized interception.

1.3.4 Order Management (Admin Panel):

A powerful and user-friendly administrative panel will be developed to provide platform administrators with comprehensive control over all aspects of order fulfillment and inventory management:

- **Product Inventory Management:** Administrators will have a centralized interface to efficiently manage the entire product inventory. This will include the ability to track real-time stock levels for each product, update inventory counts manually or through automated integrations, manage product variations (such as size, color, and other attributes), and set up low-stock alerts to proactively manage inventory levels and prevent stockouts, ensuring a consistent availability of products for customers in Bhopal and across the platform's reach.

- **User Order Management:** The admin panel will provide a comprehensive overview of all user orders placed on the platform. Administrators will be able to view detailed information for each order, including the list of purchased items, customer details, shipping address, payment information, and the total order value. They will also have the ability to track the current status of each order (e.g., pending, processing, shipped, delivered), update order statuses as they progress through the fulfillment pipeline, and manage order-related operations such as cancellations, refunds, and returns in an efficient manner.

- **Shipping Details Management:** Administrators will have the tools to manage all aspects of shipping. This may include integrating with various shipping providers to automate shipping label generation and tracking updates, configuring shipping rates based on factors like destination and order weight, and manually updating shipping information for individual orders as needed. They will also be able to generate shipping reports and track delivery performance to optimize the shipping process and ensure timely delivery to customers, including those in Bhopal, Madhya Pradesh, India.

1.3.5 Payment Integration:

The application will seamlessly integrate with secure and reputable payment gateways to offer users a diverse range of convenient and trusted payment options:

- **UPI Integration:** Direct integration with popular Unified Payments Interface (UPI) platforms, widely used in India, will enable users to make secure and instant payments directly from their bank accounts using their UPI IDs or by scanning QR codes, catering to the prevalent digital payment preferences in Bhopal and the wider Indian market.

- **Credit/Debit Card Processing:** Secure integration with leading payment processors will allow users to conveniently make payments using their major credit and debit cards (Visa, Mastercard, American Express, etc.). The application will ensure secure handling of sensitive card details through tokenization and compliance with stringent industry security standards such as PCI-DSS to protect user financial information.

- **Digital Wallet Support:** Integration with popular digital wallet services (e.g., Paytm, Google Pay, PhonePe) will provide users with an additional layer of convenience and security, allowing them to link their wallet balances to the application and complete transactions quickly and easily without having to repeatedly enter their payment details.

- **Secure Payment Processing:** All payment transactions initiated through the application will be processed securely using end-to-end encryption and industry-best practices. Communication with the integrated payment gateways will be secured using robust protocols.

1.3.6 Real-Time Notifications:

The application will incorporate a real-time notification system to proactively keep users informed about important events and enhance their engagement with the platform:

- **Order Updates:** Users will receive immediate push notifications on their mobile devices to provide real-time updates on the status of their orders. These notifications will include confirmations upon successful order placement, updates when their order has been shipped (along with tracking information to monitor delivery progress within Bhopal and beyond), and notifications upon successful delivery, keeping users informed at every stage of the fulfillment process.

- **Special Offers and Promotions:** The application will have the capability to send targeted push notifications to users about exclusive deals, limited-time discounts, and special promotions on products that align with their interests or past purchase history. This will help drive engagement, encourage repeat purchases, and ensure users don't miss out on valuable offers relevant to their shopping preferences.

- **Stock Availability Alerts:** Users who have previously viewed or expressed interest in products that were temporarily out of stock will receive automatic real-time notifications as soon as those items become available for purchase again. This feature will enhance user convenience and improve the chances of completing desired purchases, particularly for popular or previously unavailable items. These timely notifications will contribute to a more proactive and user-centric shopping experience.

1.4 INTERFACE

The system's interface is designed for simplicity and ease of use, featuring:

1.4.1 Dashboard:

The application will feature a dynamic and informative dashboard, serving as the central landing screen for users upon logging in. This personalized space will provide a quick overview of key information and facilitate easy access to essential functionalities:

- **Product Highlights:** The dashboard will showcase a curated selection of products, potentially including recently viewed items, new arrivals, featured products, and personalized recommendations based on the user's browsing history and preferences. This aims to quickly engage users with relevant content and facilitate product discovery.

- **Order Status Summary:** Users will be able to readily view a summary of their recent order statuses, such as pending shipments, orders in transit, and delivered items. This provides immediate visibility into their ongoing purchases and eliminates the need to navigate to a separate order history section for quick updates.

- **Promotional Offers:** The dashboard will prominently display ongoing promotional offers, discounts, and special deals that may be of interest to the user. This could include banners, carousels, or dedicated sections highlighting current sales events or personalized promotions, encouraging users to explore available savings and potentially make additional purchases.

1.4.2 User Profile:

Registered customers will have access to a comprehensive user profile section, empowering them to manage their personal information and track their interactions with the platform:

- **Manage Personal Details:** Users will be able to view and update their personal information, including their name, contact details (email address, phone number), and saved billing and shipping addresses relevant for deliveries within Bhopal, Madhya Pradesh, India, and other locations. This ensures their account information is accurate and up-to-date.

- **Order History:** A detailed and easily navigable order history will allow users to review all their past purchases, including order dates, items purchased, order totals, shipping addresses, and order statuses. This provides a convenient way for users to track their spending, reorder previously purchased items, and manage any potential returns or exchanges.

- **Wishlist Management:** Users will have the ability to create and manage a personalized wishlist, where they can save products they are interested in but not yet ready to purchase. This allows them to easily keep track of desired items and receive notifications (if enabled) about price changes or availability updates, enhancing their future shopping experience.

1.4.3 Admin Panel:

The administrative backend of the application will feature a powerful and intuitive Admin Panel, providing store owners with the necessary tools to efficiently manage their online business operations:

- **Inventory Management:** Store owners will have complete control over their product inventory, including the ability to add new products with detailed descriptions, images, pricing, and specifications. They can also efficiently update existing product information, manage stock levels, track inventory movements, and set up alerts for low-stock items to ensure optimal product availability for customers in Bhopal and beyond.

- **Order Management:** The Admin Panel will provide a centralized system for managing all customer orders. Store owners will be able to view detailed order information, track order statuses, process orders (e.g., mark as processing, shipped, delivered), manage cancellations and refunds, and generate order-related reports for analysis and fulfillment purposes.

- **User Interactions Management:** Store owners will have the ability to manage user accounts, view customer details, and potentially interact with customers through integrated support channels. This allows them to address customer inquiries, manage reviews and ratings, and gain insights into customer behavior to improve their offerings and customer service.

1.4.4 Order Tracking:

The application will provide users with a transparent and convenient order tracking system, allowing them to stay informed about the progress of their placed orders in real-time:

- **Real-Time Status Updates:** Once an order is placed, users will receive real-time updates on its status as it moves through the fulfillment process, from order confirmation and processing to shipment and delivery. These updates will be accessible within the user's account and potentially through push notifications.

- **Tracking Information:** Upon shipment, users will receive detailed tracking information, including the shipping carrier and a unique tracking number. This will enable them to monitor the exact location and estimated delivery time of their orders directly through the application or the shipping carrier's website, providing peace of mind and enhancing the post-purchase experience, especially for deliveries within Bhopal, Madhya Pradesh, India.

1.4.5 Mobile-Friendly Design:

The entire E-Commerce Mobile Application will be built using the Flutter framework, ensuring a consistent, high-performance, and visually appealing experience on both major mobile platforms:

- **Cross-Platform Compatibility:** Developed with Flutter's single codebase capability, the application will function seamlessly and consistently on both Android and iOS devices, providing a unified user experience regardless of the user's chosen mobile operating system.

- **Smooth Performance:** Flutter's native compilation and optimized rendering engine will ensure smooth animations, fast loading times, and responsive interactions throughout the application, providing a fluid and enjoyable shopping experience on a wide range of mobile devices, including those commonly used in Bhopal, Madhya Pradesh, India.

- **Responsive Layout:** The user interface will be designed to be responsive and adapt gracefully to different screen sizes and orientations of various mobile devices, ensuring optimal viewing and interaction on smartphones and tablets alike, enhancing accessibility and usability for all users.

1.5 DESIGN AND IMPLEMENTATION CONSTRAINTS

This project operates under the following constraints:

1.5.1 Frontend Development: Flutter for Cross-Platform Compatibility: The mobile application's user interface will be developed using Flutter, Google's open-source UI toolkit. This strategic choice offers significant advantages, primarily its ability to build natively compiled applications for multiple platforms – including both Android and iOS – from a single codebase.

1.5.2 Backend Framework: Spring Boot for Scalable Backend Operations: The application's backend infrastructure will be built using Spring Boot, a powerful and widely adopted Java-based framework. Spring Boot simplifies the development of robust and scalable backend services and microservices. Its convention-over-configuration approach, embedded server support, and extensive ecosystem make it an ideal choice for building the application's core logic, managing user authentication, handling product catalog data, processing orders, and facilitating communication with the mobile frontend.

1.5.3 Database Management: PostgreSQL for Efficient Data Handling and Storage: PostgreSQL, an advanced and open-source relational database management system, will serve as the primary data store for the E-Commerce Mobile Application. Chosen for its reliability, extensibility, and support for complex queries, PostgreSQL will ensure efficient and secure management of all critical application data, including user information, product details, inventory levels, order history, and transactional records.

1.5.4 Cloud Hosting: Aiven Cloud for Enhanced Scalability and Security: To ensure high availability, scalability, and security for the application's backend infrastructure, particularly the PostgreSQL database, Aiven Cloud will be utilized as the managed cloud service provider.

1.5.5 Third-Party Integration: Requires Integration with Payment Gateways and Cloud Services:

The E-Commerce Mobile Application will necessitate seamless integration with various third-party services to provide essential functionalities:

- **Payment Gateways:** Integration with multiple secure and reputable payment gateways (e.g., Razorpay, PayU, Stripe, PayPal, and potentially local options popular in Bhopal, Madhya Pradesh, India) is crucial for enabling secure online transactions. These integrations will handle the processing of payments via UPI, credit/debit cards, digital wallets, and net banking, ensuring a smooth and reliable checkout experience for users with diverse payment preferences. The integration process will prioritize security and compliance with relevant payment industry standards (e.g., PCI-DSS).

- **Cloud Services:** Beyond Aiven Cloud for database hosting, the application may require integration with other cloud services to enhance its functionality and scalability. This could include services for:

    - **Push Notifications:** Integration with services like Firebase Cloud Messaging (FCM) or Apple Push Notification service (APNs) will enable the delivery of real-time notifications for order updates, promotional offers, and stock availability to users on their mobile devices.

    - **Email Services:** Integration with email service providers (e.g., SendGrid, Mailgun) will be necessary for sending transactional emails such as order confirmations, shipping updates, and password reset instructions.

    - **Analytics and Monitoring:** Integration with analytics platforms (e.g., Google Analytics, Firebase Analytics) will provide valuable insights into user behavior, application performance, and potential issues, enabling data-driven decisions for optimization and improvement.

1.6 ASSUMPTIONS AND DEPENDENCIES

The successful development and operation of the E-Commerce Mobile Application are based on several key assumptions and are dependent on the proper functioning of external services and infrastructure. These are crucial factors to consider for the application's overall reliability and performance.

1.6.1 Reliable Internet Connection: A fundamental assumption for the seamless operation of the E-Commerce Mobile Application is the availability of a stable and sufficiently high-speed internet connection for users. Real-time functionalities, such as browsing product catalogs with high-resolution images, adding items to the shopping cart, proceeding through the secure checkout process, and tracking order statuses, all rely on consistent data exchange between the mobile application and the backend servers hosted on Aiven Cloud.

1.6.2 Cloud Infrastructure Availability: The E-Commerce Mobile Application's backend services and critical data storage are heavily dependent on the availability and proper functioning of Aiven Cloud and its managed PostgreSQL database service. Aiven Cloud provides the scalable and secure hosting environment necessary for the application's backend operations, ensuring high availability and resilience.

1.6.3 Secure Payment Gateway Integration: Proper Configuration of Payment Services: Secure online payment processing relies on the correct integration and configuration of reliable third-party payment gateways (UPI, cards, wallets). This includes secure data transmission, tokenization, encryption, and adherence to standards like PCI-DSS. Misconfiguration or issues with these services can cause transaction failures, financial losses, and reputational damage. Smooth and secure payments are a critical dependency.

1.6.4 Scalability and Performance Testing: While the application's architecture, leveraging Spring Boot and Aiven Cloud, is designed for scalability, it is assumed that thorough load testing will be conducted to validate its ability to handle a growing number of users and products, particularly during peak traffic periods such as festive seasons or promotional events that may see a surge in users. Scalability and performance testing are crucial to identify potential bottlenecks, optimize resource utilization, and ensure that the application can maintain smooth and responsive performance even under high load.

CHAPTER 2
SOFTWARE AND HARDWARE REQUIREMENTS

2.2 INTRODUCTION

The software and hardware requirements of a computer system are necessary for the efficient installation and use of applications. These requirements are typically provided by the application manufacturer on the packaging. If the computer system does not meet these system requirements, the application may not function properly. System requirements for the operating system will include hardware components, while other application software will list both hardware and operating system requirements, as well as browser specifications. System requirements are most commonly presented in two categories: minimum and recommended requirements. The minimum system requirements must be met for the application to run on the system, while meeting the recommended system requirements, if possible, will result in a better overall software experience.

2.2 SOFTWARE REQUIREMENTS

The following software requirements are needed for the development and execution of the E-commerce mobile application:

- Operating System: Windows/mac OS/Linux
- Frontend Framework: Flutter
- Backend Framework: Spring Boot
- Database: PostgreSQL
- Cloud Services: Aiven Cloud
- Design Tool: Figma
- Development Environment: Android Studio

2.2.1 Flutter

Flutter, an open-source User Interface (UI) framework spearheaded by Google, serves as the foundation for the application's front-end development. Its core strength lies in its ability to build natively compiled applications for a multitude of platforms – including mobile (iOS and Android), web, and desktop – all from a single, unified codebase. This cross-platform capability significantly streamlines the development process, reduces redundancy, and ensures a consistent user experience across different devices.

Flutter's architecture is built around a reactive programming model and utilizes the Dart programming language, known for its speed and developer-friendly syntax. Key advantages of employing Flutter include:

- **Fast Development with Hot-Reload:** Flutter's "Hot-Reload" feature allows developers to instantly see the effects of code changes without restarting the application, dramatically accelerating the development and debugging cycles.

- **Expressive and Customizable UI:** Flutter provides a rich set of pre-designed widgets and a highly flexible rendering engine, enabling the creation of visually appealing, fluid, and highly customized user interfaces that adhere to modern design principles.

- **High Performance:** Flutter applications are compiled directly to native code, resulting in excellent performance and smooth animations, providing a superior user experience compared to hybrid or web-based mobile solutions.

- **Rich Widget Library:** The framework boasts an extensive library of ready-to-use widgets that follow platform-specific design guidelines (Material Design for Android and Cupertino for iOS), simplifying UI development and ensuring a native look and feel.

- **Strong Community and Extensive Documentation:** Flutter benefits from a vibrant and active open-source community, along with comprehensive and well-maintained documentation, making it easier for developers to learn, troubleshoot, and find solutions.

By utilizing Flutter, the E-Commerce Mobile Application ensures a consistent and high-quality user experience across both Android and iOS platforms, while also offering the potential for future expansion to web and desktop environments with minimal additional effort.

2.2.2 Spring Boot

The backend of the E-Commerce Mobile Application is powered by Spring Boot, a highly popular and powerful Java-based framework designed to simplify the development of microservices and robust web applications. Spring Boot's core philosophy revolves around "convention over configuration," which significantly reduces boilerplate code and accelerates the development process by providing sensible default configurations for common application requirements.

Key benefits of leveraging Spring Boot for the backend include:

- **Simplified Development:** Spring Boot streamlines the setup and configuration of complex backend systems, allowing developers to focus on business logic rather than intricate infrastructure details.

- **Microservices Architecture Support:** Spring Boot is ideally suited for building microservices, enabling the application to be broken down into smaller, independent, and easily maintainable services. This architecture enhances scalability and resilience.

- **RESTful API Development:** Spring Boot provides excellent support for building RESTful APIs, which are crucial for communication between the mobile application front-end and the backend services. This ensures a standardized and efficient data exchange.

- **Embedded Server Support:** Spring Boot includes embedded web servers (like Tomcat, Jetty, or Undertow), simplifying deployment and eliminating the need for separate server installations.

- **Extensive Ecosystem and Integrations:** The Spring ecosystem offers a vast array of libraries and integrations for various functionalities, including database connectivity (Spring Data JPA), security (Spring Security), and more, providing a comprehensive toolkit for backend development.

- **Scalability and Maintainability:** Spring Boot applications are designed for scalability, allowing the backend to handle increasing user loads and data volumes effectively. The modular nature of Spring applications also contributes to better maintainability.

The adoption of Spring Boot ensures a robust, scalable, and maintainable backend system capable of efficiently handling the demands of the E-Commerce Mobile Application, including user authentication, product catalog management, order processing, and secure transaction handling.

2.2.3 PostgreSQL

PostgreSQL is the chosen Relational Database Management System (RDBMS) for the E-Commerce Mobile Application, renowned for its advanced features, open-source nature, extensibility, and unwavering reliability. It serves as the persistent data storage layer for the application, securely managing critical information such as product details, user accounts, order history, inventory levels, and transactional data.

Key advantages of utilizing PostgreSQL include:

- **Data Integrity and Reliability:** PostgreSQL is known for its strong adherence to SQL standards, ACID (Atomicity, Consistency, Isolation, Durability) properties, and robust transaction management, ensuring the integrity and consistency of the application's data.

- **Extensibility:** PostgreSQL's architecture allows for extensive customization and extension through features like user-defined functions, data types, and operators, providing flexibility to adapt to specific application requirements.

- **Support for Complex Queries:** PostgreSQL excels in handling complex SQL queries, enabling efficient retrieval and manipulation of data required for various application functionalities, such as advanced product filtering and reporting.

- **Scalability and Performance:** While being a traditional RDBMS, PostgreSQL offers features like indexing, query optimization, and partitioning that contribute to efficient performance even with large datasets. Managed services like Aiven Cloud further enhance its scalability.

- **Active Community and Long-Term Support:** As a well-established open-source project, PostgreSQL benefits from a large and active community, ensuring continuous development, bug fixes, and readily available support.

By selecting PostgreSQL, the E-Commerce Mobile Application benefits from a reliable, feature-rich, and performant database system capable of securely and efficiently managing the application's vital data.

2.2.4 Aiven Cloud

Aiven Cloud is the chosen managed cloud service provider, offering a comprehensive suite of data infrastructure services that significantly simplify the deployment, management, and scaling of critical components of the E-Commerce Mobile Application, particularly the PostgreSQL database. By leveraging Aiven Cloud, the development team can focus on building application features rather than managing complex infrastructure.

Key benefits of integrating Aiven Cloud include:

- **Managed PostgreSQL Service:** Aiven provides a fully managed PostgreSQL service, handling tasks such as installation, configuration, backups, monitoring, and upgrades automatically. This reduces operational overhead and ensures the database is always running optimally.
- **Scalability and High Availability:** Aiven's infrastructure is designed for scalability and high availability. The PostgreSQL service can be easily scaled up or down based on application demand, and built-in redundancy ensures minimal downtime.
- **Security:** Aiven Cloud implements robust security measures, including encryption at rest and in transit, network isolation, and regular security audits, ensuring the protection of sensitive application data.
- **Global Infrastructure:** Aiven's availability across multiple cloud providers and regions allows for deploying the application's backend infrastructure closer to the target user base in Bhopal, Madhya Pradesh, India, and potentially other regions, minimizing latency and improving performance.
- **Monitoring and Logging:** Aiven provides comprehensive monitoring and logging tools, offering insights into the performance and health of the managed services, enabling proactive issue detection and resolution.

The integration with Aiven Cloud ensures that the E-Commerce Mobile Application's backend infrastructure, particularly the PostgreSQL database, is highly reliable, scalable, secure, and requires minimal manual management, allowing the development team to concentrate on delivering core application value.

2.2.5 Figma

Figma is a web-based UI/UX design tool that plays a critical role in the initial phases of the E-Commerce Mobile Application development lifecycle. It serves as a collaborative platform for designers and developers to work together in real-time to create intuitive, visually appealing, and user-centered interfaces.

Key benefits of utilizing Figma include:

- **Collaborative Design:** Figma's real-time collaboration features allow multiple designers and developers to work on the same design simultaneously, fostering seamless communication and iterative design processes.
- **Prototyping Capabilities:** Figma enables the creation of interactive prototypes, allowing stakeholders to experience the intended user flows and interactions before development begins. This helps in identifying usability issues early in the process.
- **Version Control:** Figma automatically tracks design changes, providing a clear history and allowing for easy reversion to previous versions.
- **Developer Handoff:** Figma facilitates a smooth handoff from design to development by providing developers with access to design specifications, including measurements, colors, fonts, and assets, directly from the design files.
- **Web-Based Accessibility:** Being a web-based tool, Figma is accessible from any operating system with a web browser, promoting flexibility and collaboration across different teams and environments.

By employing Figma, the E-Commerce Mobile Application ensures a well-thought-out and user-validated design, leading to a more intuitive and engaging user experience and reducing potential rework during the development phase.

2.2.6 Android Studio

Android Studio is the official Integrated Development Environment (IDE) specifically designed for Android application development. While Flutter enables cross-platform development, Android Studio provides essential tools and features for developing, debugging, and testing the Android-specific build of the E-Commerce Mobile Application.

Key benefits of utilizing Android Studio include:

- **Code Editing and Completion:** Android Studio offers intelligent code editing features, including syntax highlighting, code completion, and error checking, which significantly enhance developer productivity.
- **Debugging Tools:** The IDE provides powerful debugging tools that allow developers to step through code, inspect variables, and identify and resolve issues efficiently.
- **Layout Editor:** Android Studio features a visual layout editor that simplifies the process of designing user interfaces for Android devices, allowing developers to drag and drop UI components and configure their properties.
- **Emulator and Device Testing:** The IDE includes an Android emulator for testing the application on virtual devices with various configurations. It also provides tools for deploying and testing the application on physical Android devices.
- **Performance Analysis Tools:** Android Studio offers tools for profiling the application's performance, identifying bottlenecks, and optimizing resource usage.
- **Integration with SDK and Build Tools:** As the official IDE, Android Studio is tightly integrated with the Android Software Development Kit (SDK) and build tools, ensuring compatibility and access to the latest Android features.

2.3 HARDWARE REQUIREMENTS

- Processor: Intel Core i5/i7 or AMD equivalent (Recommended).
- RAM: 8 GB (Minimum), 16 GB (Recommended).
- Storage: 10 GB of available disk space (IDE + Flutter SDK + Android Emulator)
- Screen Resolution: 1920 x 1080 minimum
- Internet Connection: Stable connection for cloud services and API integration

CHAPTER 3
PROBLEM DESCRIPTION

3.1 OVERVIEW

With the rapid growth of online shopping, businesses need efficient and scalable e-commerce platforms to provide seamless user experiences. Many traditional retail businesses struggle with digital transformation, and even existing e-commerce solutions often face challenges such as poor performance, security vulnerabilities, and limited scalability. Additionally, small and medium-sized businesses find it difficult to maintain cost-effective e-commerce solutions that integrate well with modern technologies.

The key problems identified include:

3.1.1 Limited Accessibility and User Experience: A significant number of existing e-commerce platforms suffer from suboptimal User Interface (UI) and User Experience (UX) design. This often manifests as clunky navigation, inconsistent design elements across different sections, and a lack of responsiveness on various screen sizes and devices. Consequently, users encounter frustration while attempting to browse product catalogs, search for specific items, add products to their carts, proceed through the checkout process, and manage their order histories. The absence of intuitive design principles and a lack of focus on user-centricity lead to high bounce rates, cart abandonment, and overall dissatisfaction with the online shopping journey.

3.1.2 Inefficient Backend and Performance Issues: The backbone of any successful e-commerce platform is its backend infrastructure. Many existing solutions are hampered by slow and unoptimized backend systems. This can stem from a variety of factors, including inefficient database schemas and queries, poorly managed Application Programming Interfaces (APIs), and inadequate server resources. The resulting sluggish performance directly impacts both customers and administrators. Customers experience prolonged page loading times, delays during the checkout process, and potential failures in completing transactions. Simultaneously, administrators face challenges in managing the platform effectively, including slow product updates, difficulties in generating reports, and overall system unresponsiveness, hindering their ability to efficiently operate their online business.

3.1.3 Security Concerns and Data Protection: E-commerce platforms are prime targets for cyber threats due to the sensitive nature of the data they handle. This includes Personally Identifiable Information (PII) such as customer names, addresses, email addresses, phone numbers, and critically, payment details like credit card information. Many existing platforms exhibit security vulnerabilities arising from weak authentication and authorization mechanisms, inadequate encryption of data both in transit and at rest, and insufficient protection against common web application attacks. These security shortcomings expose both customers and business owners to significant risks, including financial fraud, data breaches, and reputational damage. Robust security measures and adherence to data protection regulations are paramount for building trust and ensuring the longevity of an e-commerce platform.

3.1.4 Inventory and Order Management Challenges: Effective inventory and order management are crucial for the smooth operation of any e-commerce business. However, many platforms struggle with providing accurate and real-time inventory tracking. This can lead to scenarios where businesses inadvertently sell products that are out of stock (overselling), resulting in customer disappointment and logistical complications. Conversely, a lack of visibility into stock levels can lead to understocking, potentially missing out on sales opportunities. Reliance on manual inventory management processes or poorly designed database structures further exacerbates these issues, leading to errors, delays in order fulfillment, and ultimately, customer dissatisfaction. A well-integrated and automated inventory management system is essential for maintaining accurate stock levels, streamlining order processing, and ensuring timely delivery.

3.1.5 Payment Gateway Integration and Transaction Failures: The seamless integration of secure and reliable payment gateways is a fundamental requirement for any successful e-commerce platform. However, many platforms encounter difficulties in this area. Issues can range from limited support for diverse payment options preferred by customers (especially in specific regions like Bhopal, Madhya Pradesh, India, where local payment methods are prevalent) to technical glitches during transaction processing, leading to frequent transaction failures. Long processing times during checkout can also deter customers from completing their purchases. A robust and versatile payment gateway integration is critical for providing a smooth and trustworthy payment experience, ultimately driving sales and customer confidence.

3.1.6 Scalability and Cloud Infrastructure: As e-commerce businesses experience growth, their underlying infrastructure must be capable of scaling efficiently to handle increasing volumes of website traffic, transactions, and data storage. Many businesses, particularly smaller or those utilizing older technologies, face significant challenges in scaling their infrastructure effectively and cost- efficiently. Inadequate server capacity, inefficient resource allocation, and a lack of cloud-native architecture can lead to performance degradation during peak traffic periods, impacting the user experience and potentially resulting in lost sales. A scalable and robust cloud infrastructure is essential for accommodating growth and ensuring consistent performance under varying loads.

3.1.7 **Need for a robust E-Commerce Solution and Project Objectives:** The contemporary digital marketplace demands robust, scalable, and user-centric e-commerce solutions that can effectively cater to the evolving needs of both consumers and businesses. Recognizing the limitations and challenges often encountered with existing e-commerce platforms, this project is driven by the critical need to develop a high-performance E-Commerce Mobile Application. Our core objective is to leverage a cutting-edge technology stack – featuring Flutter for a dynamic and cross-platform frontend, Spring Boot for a resilient and scalable backend, PostgreSQL for reliable and efficient data management, and Aiven Cloud for a robust and managed cloud infrastructure – to create a superior online shopping ecosystem.

3.1.8 User Engagement and Customer Retention Strategies: A key focus of this project extends beyond basic transactional capabilities to encompass the critical aspects of user engagement and long-term customer retention. We understand that in today's competitive online market, simply providing a platform for buying and selling is insufficient. To foster a thriving e-commerce environment, it is essential to cultivate meaningful interactions with users and build lasting relationships. Therefore, this application will incorporate several strategic features designed to enhance user engagement and drive customer loyalty.

3.1.9 Admin and Vendor Panel for Business Owners: Recognizing the diverse needs of stakeholders within the e-commerce ecosystem, this project includes the development of comprehensive administrative and vendor management panels. These dedicated interfaces are designed to empower business owners with the tools necessary to efficiently manage their online operations and drive growth. The **Admin Panel** will serve as a central hub for platform administrators, providing functionalities to oversee all aspects of the e-commerce platform. This includes robust product management capabilities, allowing administrators to easily add, edit, and categorize products, manage pricing and promotions, and monitor overall inventory levels. The admin panel will also facilitate efficient order management, enabling administrators to track order statuses, process shipments, and handle returns or refunds.

3.10 Future Enhancements: The initial phase of this project will lay a strong foundation for a robust e-commerce platform. Future iterations may explore and incorporate advanced features to further enhance the platform's capabilities and user experience, including:

- **AI-Driven Product Recommendations:** Implementing machine learning algorithms to analyze user behavior and provide highly personalized product suggestions.
- **Chatbots for Customer Support:** Integrating intelligent chatbots to provide instant responses to common customer queries and enhance customer support efficiency.
- **Multi-Vendor Support:** Expanding the platform to support multiple vendors, allowing various businesses to sell their products through a unified marketplace.
- **Blockchain-Based Security for Transaction Transparency:** Investigating the potential of blockchain technology to enhance the security and transparency of transactions within the platform.

CHAPTER 4
LITERATURE SURVEY

The rapid growth of e-commerce has revolutionized the retail industry, offering convenience, accessibility, and a seamless shopping experience to consumers. Various research studies have explored different aspects of e-commerce, including security, personalization, user experience, and technological advancements. Below is a review of relevant literature that provides insights into the evolution and impact of e-commerce platforms.

From [1] (J. Smith, 2022)

This study explores the role of Artificial Intelligence (AI) in e-commerce, emphasizing personalized recommendations and automated customer service. AI-driven chatbots, predictive analytics, and recommendation engines significantly enhance user engagement and increase conversion rates. The paper highlights how AI algorithms analyze customer behavior to provide a more tailored shopping experience, improving customer satisfaction and retention.

From [2] (M. Johnson & R. Patel, 2021)

The research focuses on the security challenges of online transactions in e-commerce. It examines the vulnerabilities in payment gateways, the effectiveness of encryption technologies, and the role of blockchain in securing digital transactions. The study concludes that integrating blockchain technology into e-commerce platforms can significantly enhance transaction security, reducing the risk of fraud and unauthorized access.

From [3] (L. Brown, 2020)

This paper discusses the impact of mobile commerce (m-commerce) on the retail sector. With the increasing adoption of smartphones, businesses are shifting towards mobile-friendly platforms to cater to a larger audience. The study highlights key factors such as mobile app usability, fast-loading pages, and secure payment gateways that influence consumer trust and purchasing behavior in m-commerce.

From [4] (A. Kumar & P. Singh, 2019)

This research explores the logistics and supply chain challenges in e-commerce. It identifies major obstacles such as last-mile delivery inefficiencies, inventory management issues, and the growing need for sustainable packaging solutions. The paper proposes AI-driven logistics and real-time tracking systems as viable solutions to streamline e-commerce supply chains and improve operational efficiency.

From [5] (D. Williams et al., 2018)

The study investigates the influence of social media on e-commerce sales. It highlights how platforms like Instagram, Facebook, and TikTok are being leveraged for marketing and direct shopping experiences. The study discusses the rise of social commerce and the effectiveness of influencer marketing in driving sales.

From [6] (K. Lee & J. Anderson, 2017)

This research focuses on consumer behavior in e-commerce, analyzing factors that drive purchasing decisions. The study identifies key motivators such as competitive pricing, product reviews, website design, and ease of checkout. It concludes that a seamless user experience and trust-building mechanisms significantly impact conversion rates.

From [7] (S. Martinez, 2016)

This paper examines the role of big data in enhancing e-commerce operations. It explains how data analytics can predict consumer trends, optimize pricing strategies, and improve customer relationship management. The study finds that businesses leveraging big data analytics see a notable increase in customer satisfaction and revenue growth.

CHAPTER 5
SOFTWARE REQUIREMENT SPECIFICATION

5.1 FUNCTIONALREQUIREMENTS

5.1.1 User Registration & Authentication: The application will feature a secure and intuitive user registration and authentication system. New users will be able to easily sign up using their email address or phone number, along with a secure password. Existing users will have a seamless login experience using their registered credentials. Furthermore, users will have the ability to manage their accounts, including updating their profile information, managing saved addresses, and securely resetting their passwords if needed, ensuring control over their personal data.

5.1.2 Product Management: The administrative backend of the application will provide comprehensive product management capabilities. Administrators will have the authority to add new products to the catalog, including detailed descriptions, high-quality images showcasing various aspects of the product, and accurate pricing information. They will also be able to efficiently update existing product details, such as descriptions, images, prices, and specifications, as well as remove products from the platform when necessary, ensuring the product catalog remains current and accurate.

5.1.3 Shopping Cart & Checkout: The application will feature a user-friendly shopping cart system that allows customers to easily add desired items to their virtual cart while browsing. Users will have the ability to review the items in their cart, adjust quantities, and remove items before proceeding to checkout. The checkout process will be designed to be smooth and efficient, guiding users through clear steps to provide shipping information, select delivery options, and apply valid discount codes or promotional offers before finalizing their purchase.

5.1.4 Payment Integration: To cater to a wide range of user preferences and ensure transaction convenience, the application will integrate with multiple secure payment gateways. This will include support for major credit and debit cards, popular Unified Payments Interface (UPI) options widely used in India, net banking facilities offered by various banks, and digital wallets, providing users with a variety of trusted and familiar payment methods to complete their transactions securely and efficiently.

5.1.5 Order Management: The application will provide users with comprehensive order management functionalities. Once an order is placed, users will be able to easily track its progress in real-time, receiving updates on its status from processing to shipment and delivery. They will also have access to a detailed view of their order history, allowing them to review past purchases, track spending, and manage any potential returns or exchanges, providing transparency and control over their buying activity.

5.1.6 Review & Ratings: To foster a sense of community and provide valuable insights to potential buyers, the application will allow customers who have purchased a product to submit reviews and provide ratings based on their experience. These reviews and ratings will be publicly visible on the product pages, helping other users make informed purchasing decisions and providing valuable feedback to vendors and administrators regarding product quality and customer satisfaction.

5.1.7 Search & Filtering: The application will incorporate a robust search functionality, enabling users to quickly find desired products by entering keywords related to the product name, category, or description. Additionally, users will be able to refine their search results using comprehensive filtering options based on various criteria such as product categories, price ranges, customer ratings, and other relevant attributes, making it easier to narrow down their choices and discover the perfect products.

5.1.8 Admin Dashboard: The administrative backend will feature an intuitive and informative dashboard providing administrators with a centralized overview of the platform's key metrics and operational data. This dashboard will enable administrators to efficiently manage inventory levels, monitor sales analytics to understand trends and performance, track user activity to gain insights into customer behavior, and access other critical information necessary for effective platform management and business decision-making.

5.1.9 Notifications: To keep users informed and engaged, the application will implement a notification system. Users will receive timely alerts for important events such as order confirmations upon successful placement, shipment notifications with tracking details, announcements of special promotions and discounts, and notifications when previously out-of-stock items they were interested in have been restocked, enhancing their overall shopping experience and keeping them connected with the platform.

5.1.10 Customer Support: The application will provide integrated customer support channels to assist users with any queries, issues, or concerns they may encounter. This will include the implementation of either a real-time chat support feature, allowing for direct communication with support agents, or a ticket-based assistance system where users can submit their inquiries and receive timely responses, ensuring that users have access to the help they need for a positive and hassle-free experience.

5.2 NON-FUNCTIONALREQUIREMENTS

These requirements define the quality attributes and operational characteristics of the E-Commerce Mobile Application, ensuring it meets the expectations of users and business owners in terms of performance, reliability, security, and maintainability.

5.2.1 Scalability: The application must be designed with scalability as a core principle, capable of seamlessly supporting a growing number of registered users and an expanding product catalog without experiencing any noticeable degradation in performance. The underlying architecture, particularly the backend services powered by Spring Boot and the managed PostgreSQL database on Aiven Cloud, will be engineered to handle increasing traffic loads and data volumes efficiently, ensuring a consistent and responsive experience even during peak shopping periods.

5.2.2 Reliability: The E-Commerce Mobile Application is expected to provide a highly reliable service, aiming for a minimum uptime of 99.9%. This necessitates a robust infrastructure with redundancy and failover mechanisms in place, particularly within the Aiven Cloud environment hosting the critical backend components. Consistent monitoring, proactive maintenance, and efficient error handling will be implemented to minimize downtime and ensure uninterrupted shopping experiences for users, fostering trust and dependability in the platform.

5.2.3 Security: Security is a paramount concern for the E-Commerce Mobile Application. The system must implement comprehensive security measures to protect all user data, transaction details, and other sensitive information from unauthorized access, breaches, and cyber threats. This includes robust encryption techniques for data both in transit (e.g., using HTTPS) and at rest within the database, secure authentication and authorization protocols to verify user identities and control access, and adherence to industry best practices for secure coding and vulnerability management.

5.2.4 Performance: The application must deliver optimal performance to ensure a smooth and engaging user experience. Key performance indicators include fast load times for all pages and functionalities, with a target of pages loading within 3 seconds. Efficient database queries, optimized backend processing, and effective caching mechanisms will be implemented to minimize latency and provide users with quick and responsive interactions throughout the application, enhancing satisfaction and reducing frustration.

5.2.5 Usability: The E-Commerce Mobile Application will prioritize usability by providing an intuitive, user-friendly, and mobile-first UI. The design will adhere to established mobile design patterns and guidelines, ensuring ease of navigation, clear information architecture, and a visually appealing interface that is consistent across different mobile devices and screen sizes. Thorough user testing and feedback will be incorporated throughout the development process to ensure a seamless and enjoyable shopping experience for all users, regardless of their technical proficiency.

5.2.6 Maintainability: The application's codebase will be developed with maintainability in mind, employing a modular architecture, clear coding standards, and comprehensive documentation. This approach will facilitate easier updates, bug fixes, and the integration of new features in the future, reducing the complexity and cost associated with ongoing maintenance and evolution of the platform. Well-structured and documented code will also enable efficient collaboration among development team members.

5.2.7 Cost-Effectiveness: While prioritizing performance and reliability, the project will also focus on cost-effectiveness in terms of hosting and infrastructure expenses. Utilizing managed cloud services like Aiven Cloud for database hosting will help optimize operational costs by reducing the need for extensive in-house infrastructure management. Efficient resource utilization and careful selection of hosting plans will be considered to ensure a balance between performance and affordability, making the platform sustainable in the long run.

5.2.8 Compliance: The E-Commerce Mobile Application will adhere to relevant data protection regulations and industry standards to ensure the privacy and security of user data. This includes compliance with regulations such as the General Data Protection Regulation (GDPR) for users in relevant regions and the Payment Card Industry Data Security Standard (PCI-DSS) for handling payment card information securely. Implementing necessary security controls and adhering to these compliance frameworks will be a critical aspect of the application's development and deployment.

5.3 PERFORMANCE

This section outlines specific, measurable performance targets and detailed security implementations crucial for the success and user trust in the E-Commerce Mobile Application.

5.3.1 Search Functionality: When a user initiates a product search, the application must display relevant search results to the user within a maximum of 2 seconds. This includes processing the search query against the product catalog and rendering the list of matching items with associated details.

5.3.2 Checkout Speed: Upon the user initiating the payment process during checkout, the application must complete the transaction within a maximum of 5 seconds. This timeframe encompasses the communication with the payment gateway, authorization of the payment.

5.3.3 Inventory Sync: The application's inventory management system must update stock levels in real time whenever a purchase is made or inventory is adjusted. This immediate synchronization is critical to prevent overselling scenarios and ensure accurate product availability information is consistently displayed to users.

5.3.4 Data Retrieval: When a user requests to view their order history or access detailed information about a specific product, the application must fetch and display this data within a maximum of 2 seconds. This requirement ensures quick access to frequently accessed information, enhancing user convenience and efficiency.

5.4 SECURITY IMPLEMENTATIONS:

5.4.1 Authentication: To enhance account security, the application will implement two-factor authentication (2FA) for user logins. This will require users to provide an additional verification code, typically sent to their registered mobile device or email address, in addition to their password, significantly reducing the risk of unauthorized account access.

5.4.2 Data Encryption: All sensitive data transmitted between the mobile application and the backend servers will be protected using Transport Layer Security (TLS) encryption, ensuring confidentiality and integrity during transit. Furthermore, all sensitive data stored within the application's database, such as user credentials and payment information, will be encrypted using the Advanced Encryption Standard (AES) algorithm to safeguard it against unauthorized access at rest.

5.4.3 Access Control: The application will implement a robust role-based access control (RBAC) system. Administrative functionalities and access to sensitive operations, such as managing user accounts, processing refunds, and modifying critical system settings, will be strictly restricted to authorized administrator roles. Similarly, vendor-specific operations will be limited to their designated areas within the vendor panel, ensuring data segregation and preventing unauthorized actions.

5.4.4 Security Audits: To proactively identify and address potential security vulnerabilities, regular security audits will be conducted. These audits will involve thorough vulnerability assessments and penetration testing by security professionals to evaluate the application's resilience against known and emerging threats, ensuring a proactive approach to maintaining a secure platform.

5.4.5 Fraud Prevention: The application will incorporate mechanisms to detect suspicious transaction patterns and block unauthorized access attempts. This may include analyzing user behavior, identifying unusual activity, and implementing fraud detection algorithms to mitigate the risk of fraudulent transactions and protect both the platform and its users from financial losses.

5.4.6 Data Integrity: Measures will be implemented throughout the application to ensure the integrity of data stored within the system. This includes utilizing database constraints, input validation techniques, and audit logging to prevent data tampering, maintain data accuracy, and provide a reliable record of all critical operations and changes within the platform.

5.4 : USABILITY FEATURES

5.5.1 User-Friendly Interface: The application will be meticulously designed to feature a simple, intuitive, and visually engaging user interface. The navigation will be clear and straightforward, allowing users to easily browse products, manage their cart, and complete purchases without confusion or frustration, ensuring a seamless and enjoyable shopping experience.

5.5.2 Accessibility: The application will strive to support multiple languages relevant to its target user base, including Hindi given the location in Bhopal, Madhya Pradesh, India. Furthermore, efforts will be made to adhere to the Web Content Accessibility Guidelines (WCAG) to ensure the application is usable by individuals with disabilities, promoting inclusivity and broader accessibility.

5.5.3 Feedback Mechanism: The application will provide clear and timely feedback to users through various mechanisms. This includes displaying clear notifications for successful actions (e.g., adding to cart, order confirmation), providing confirmations upon successful completion of processes (e.g., payment successful), and displaying informative and user-friendly error messages with guidance on how to resolve issues, ensuring transparency and effective communication.

5.5.4 Customization: To enhance user convenience and personalization, the application will allow users to set preferences for various aspects of their experience. This may include customizing notification settings (e.g., choosing which types of notifications they receive) and saving preferred payment options for faster checkout in future transactions, providing a more tailored and efficient shopping experience.

5.5.5 Error Handling: The application will implement robust error handling mechanisms to gracefully manage unexpected issues such as failed transactions or navigation errors. When errors occur, the application will provide helpful and informative messages to the user, along with clear options for recovery, such as retrying the action or navigating to a different section, minimizing user frustration and guiding them towards a resolution.

CHAPTER 6
SOFTWARE DESIGN

6.1 USE CASE DIAGRAM

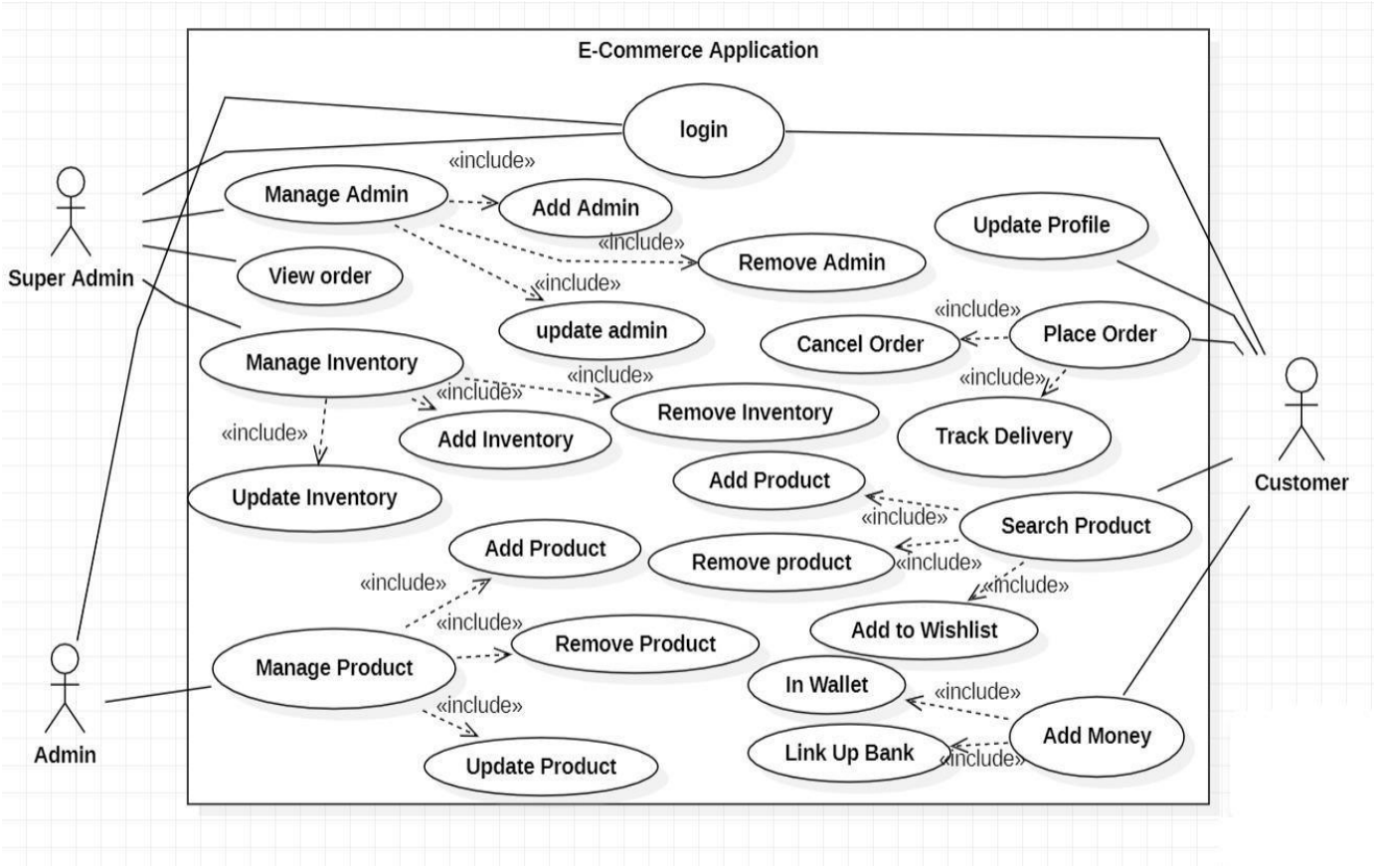

Figure 6.1: Use Case Diagram

6.2 ENTITY RELATION DIAGRAM

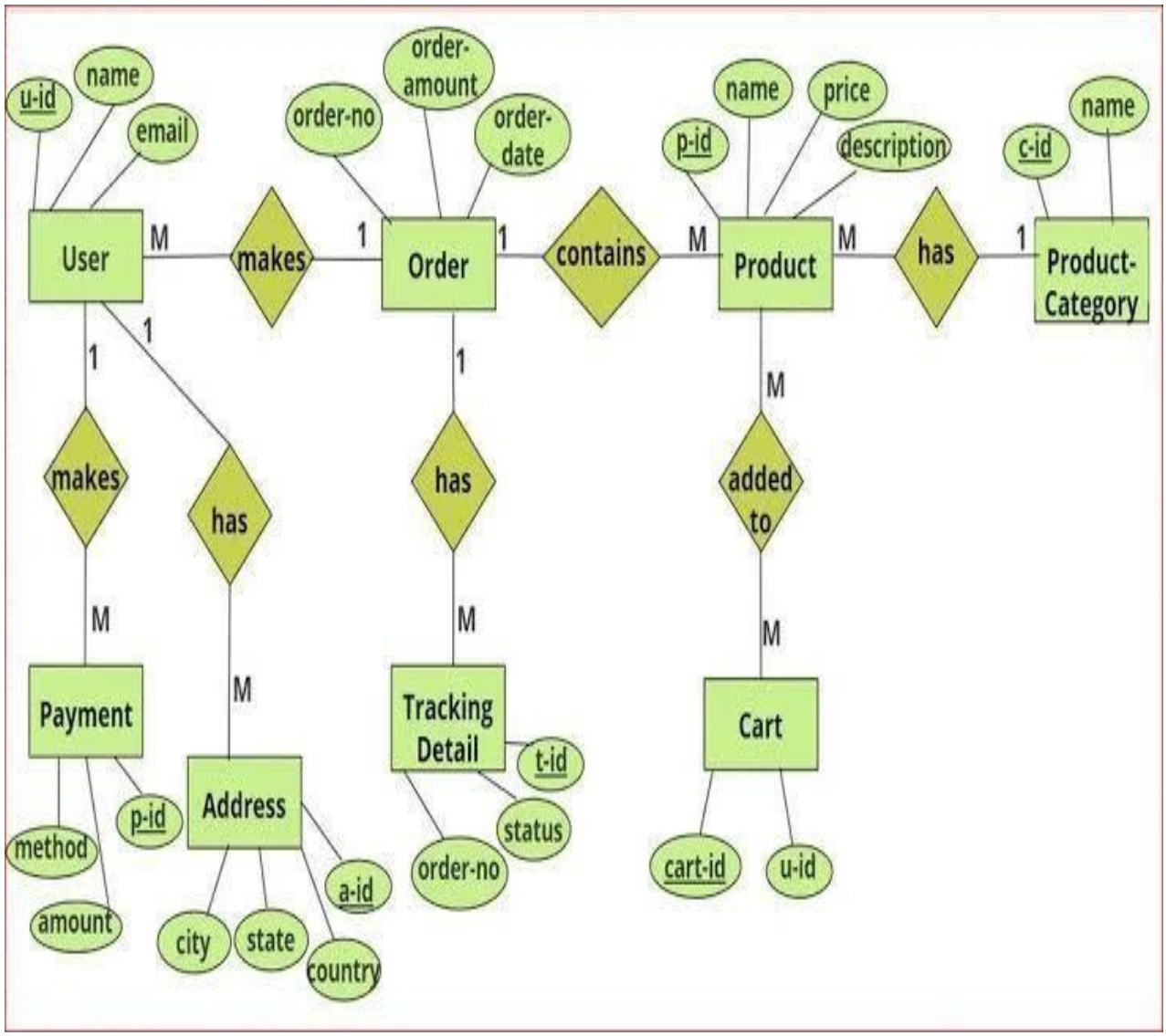

Figure 6.2: E R Diagram

6.3 TABLE STRUCTURE OF DATABASE

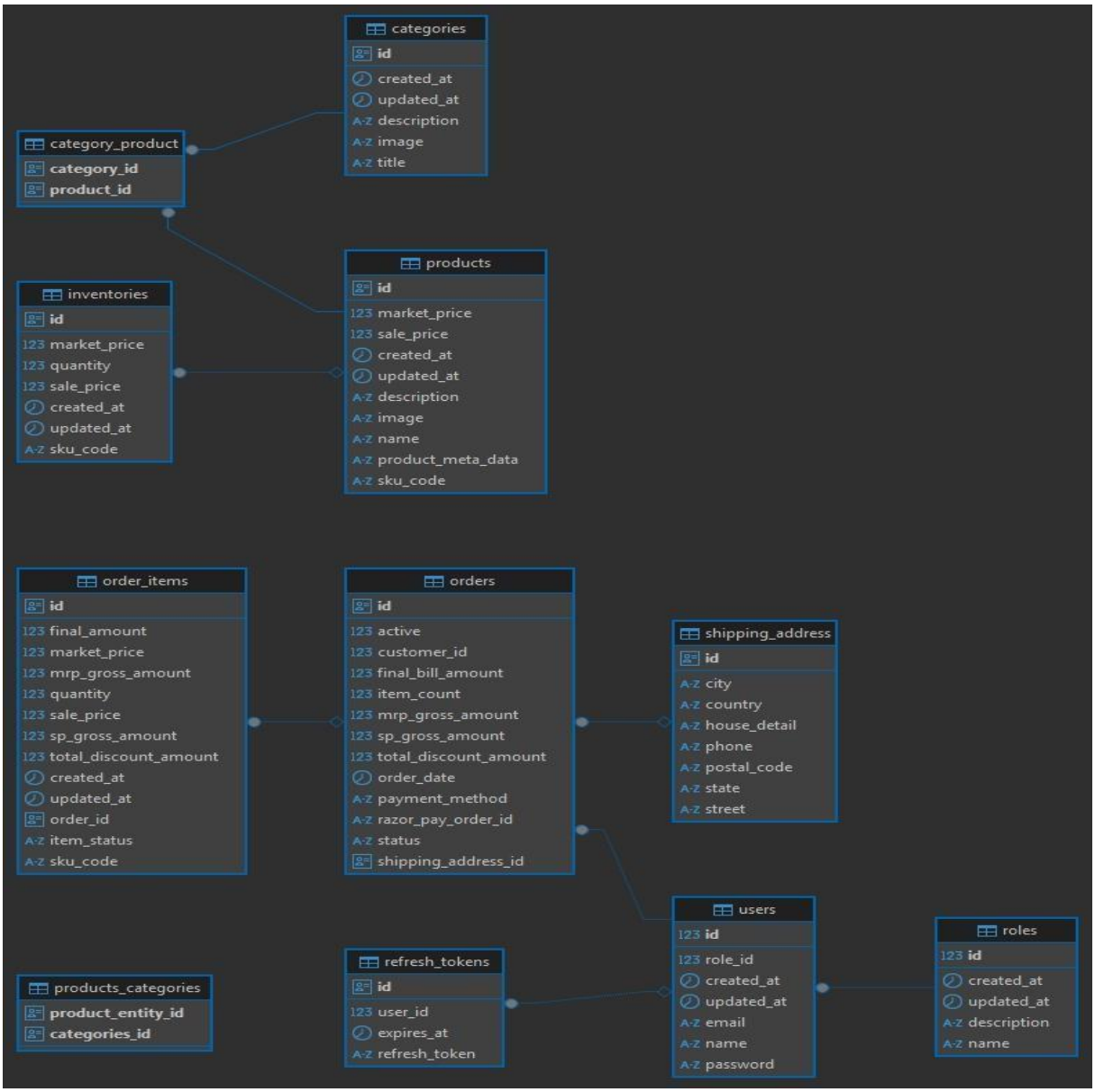

Figure 6.3:Table Structure of Database

CHAPTER 7
OUTPUT SCREEN

7.1 USER OUTPUT SCREEN

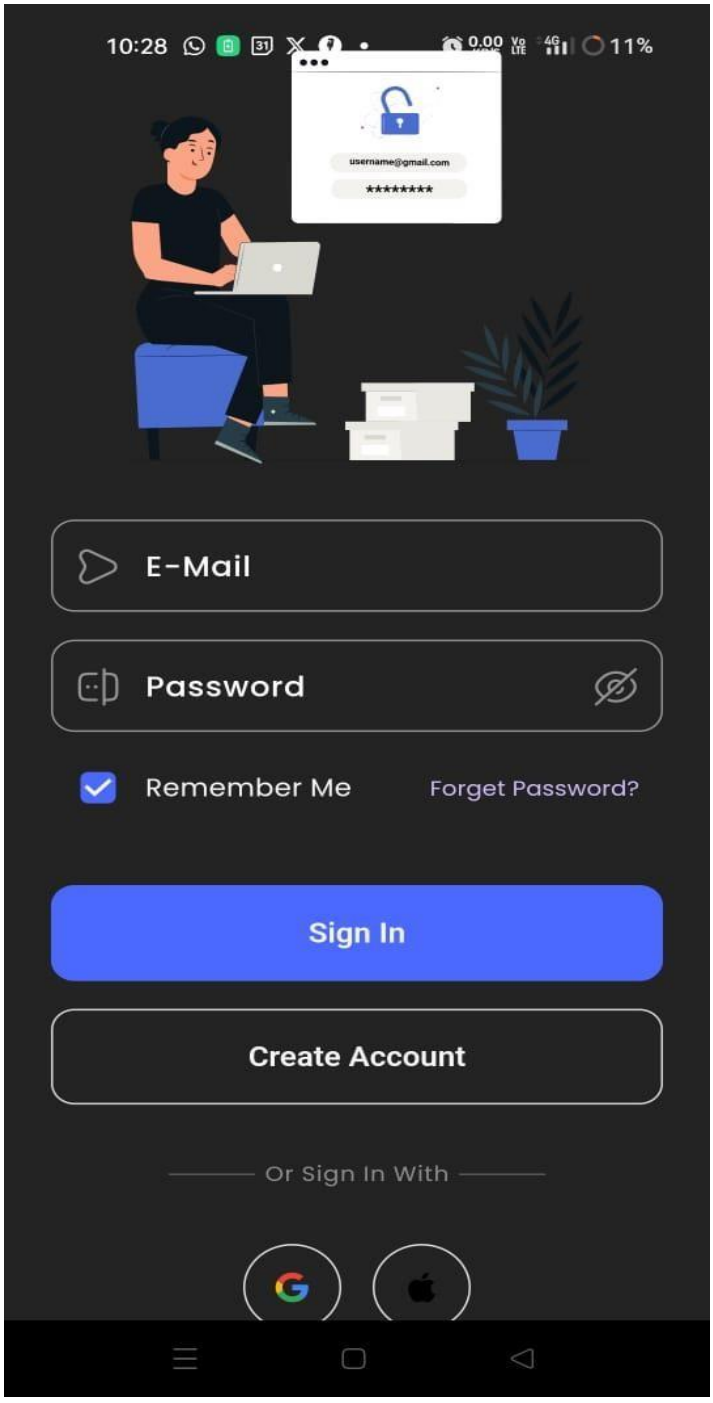

Figure 7.1: Sign-In Screen

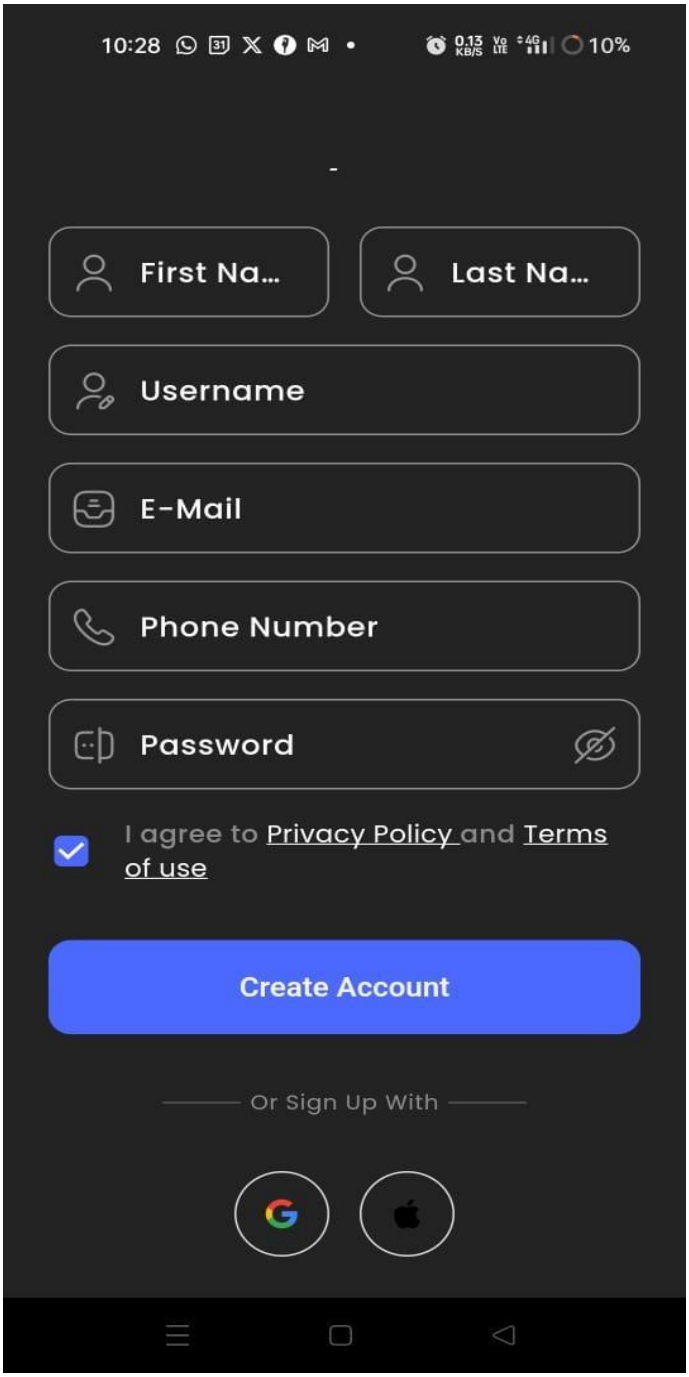

Figure 7.2: Register Screen

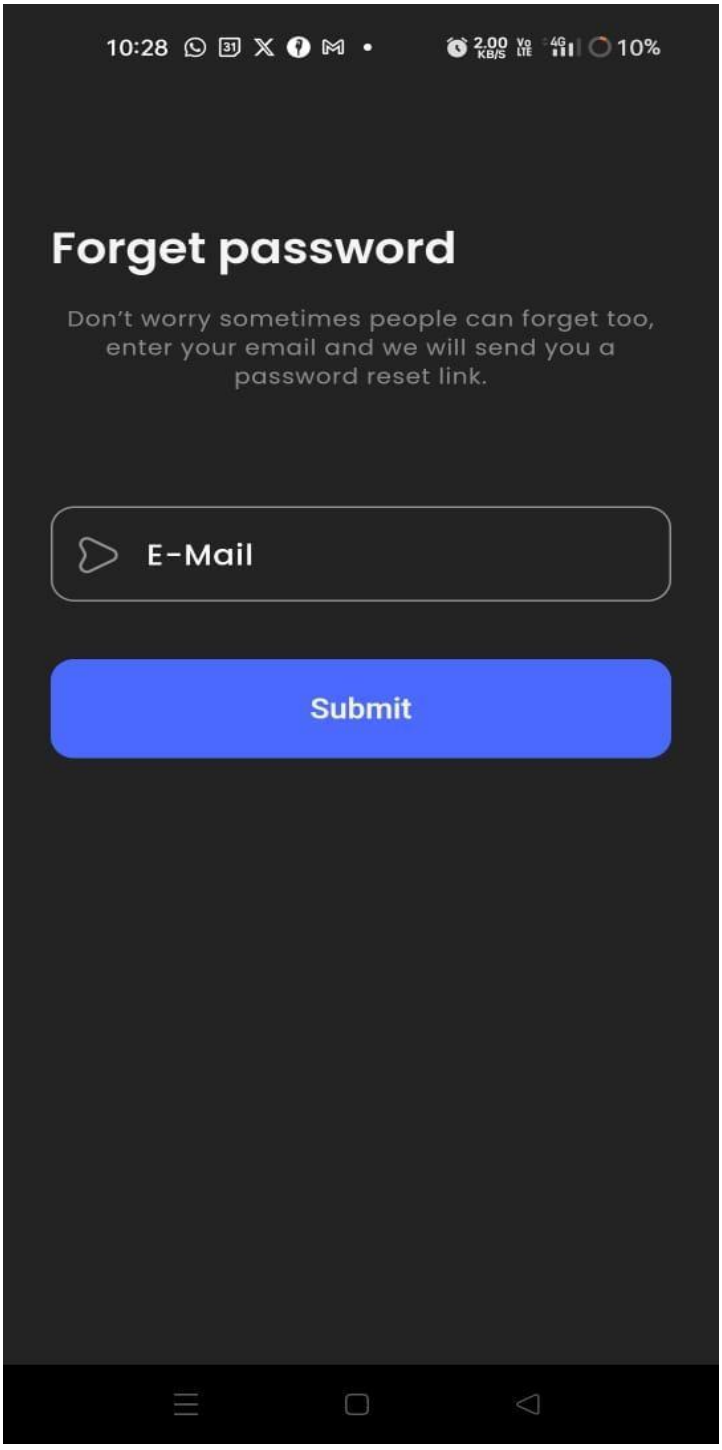

Figure 7.3: Forget Password Screen

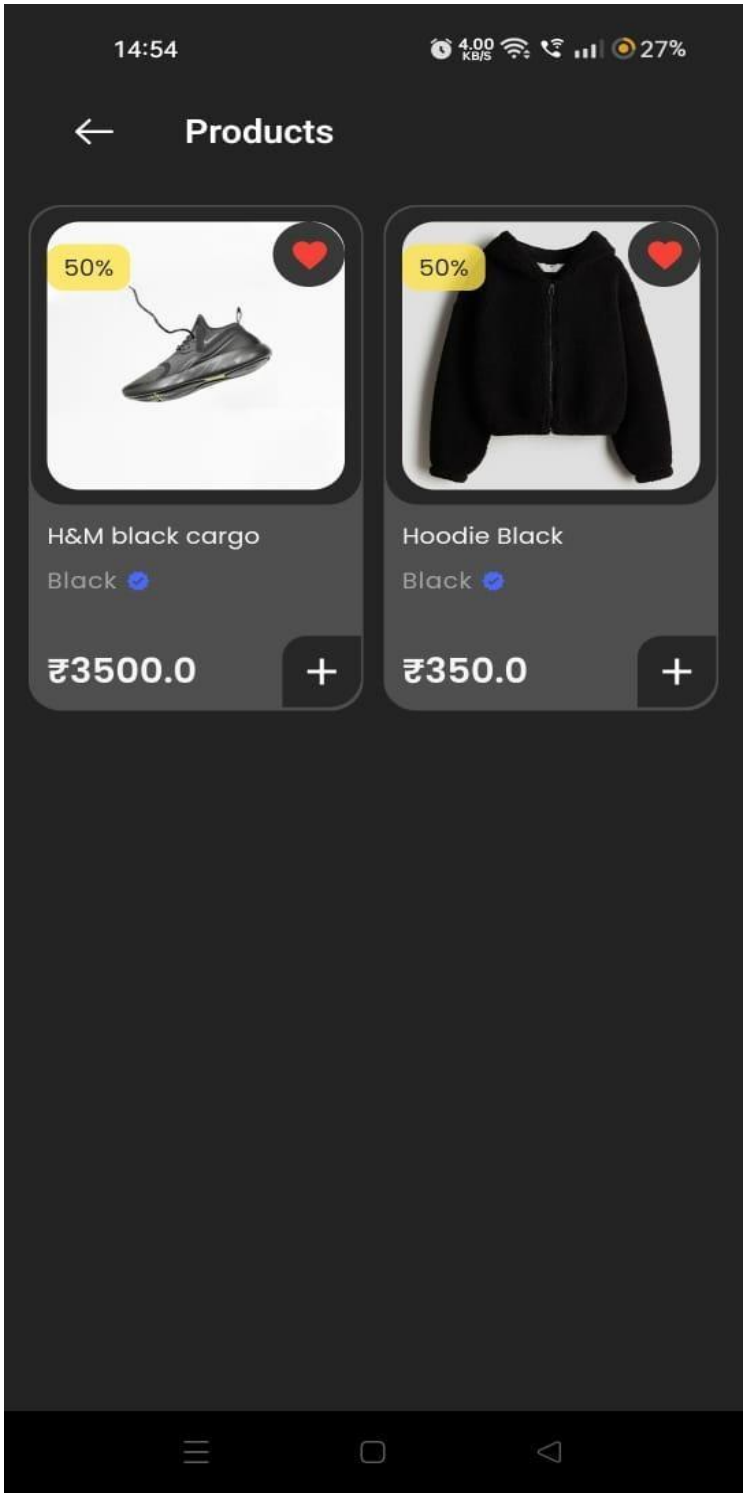

Figure 7.4: Product Screen

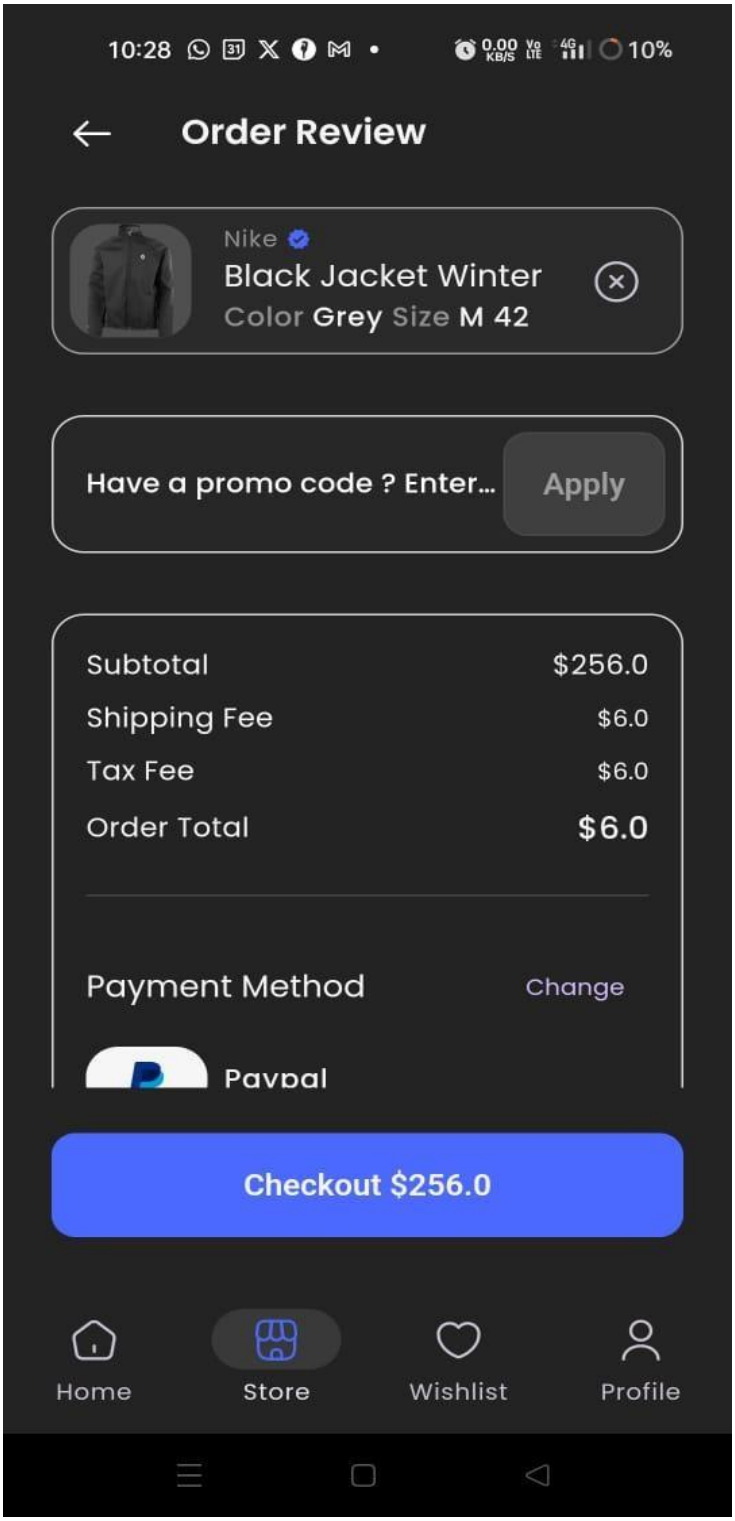

Figure 7.5: Store Screen

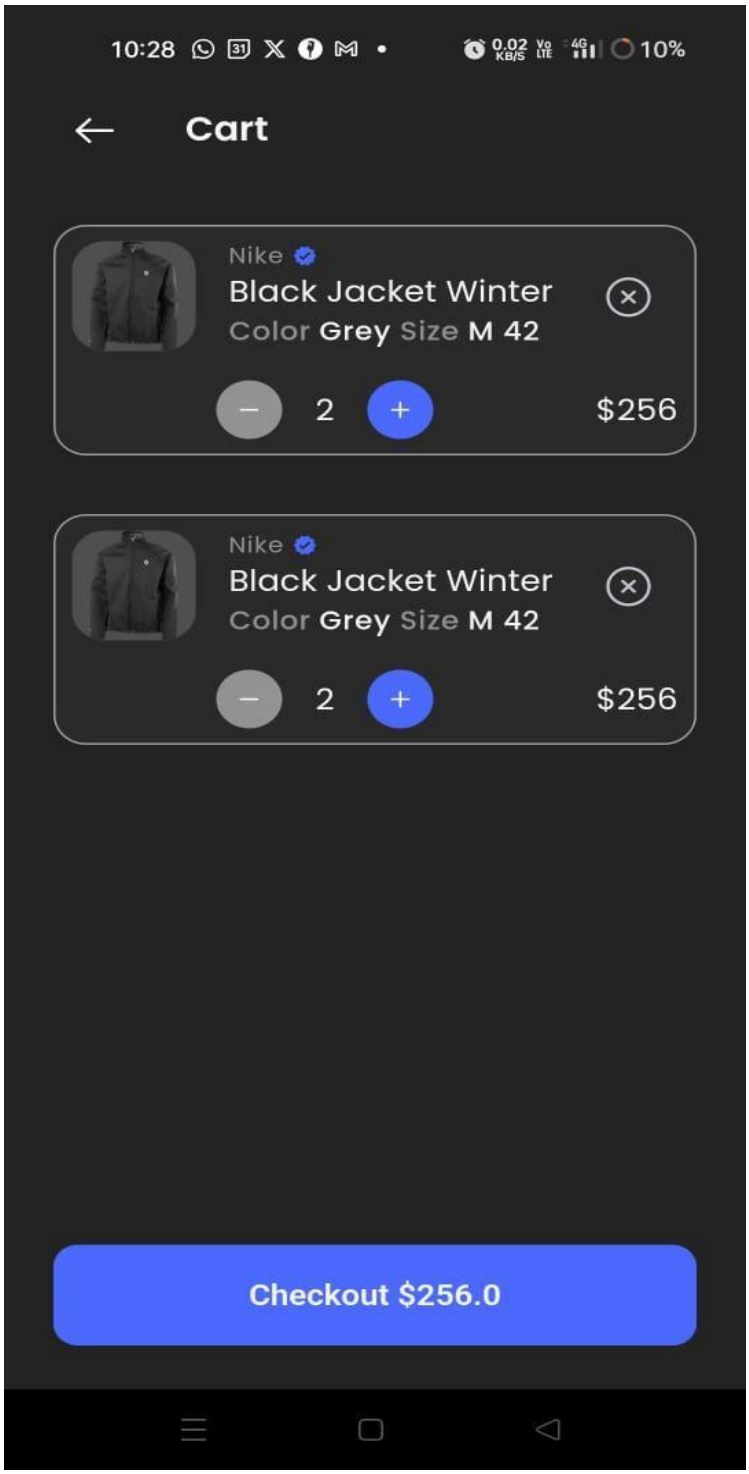

Figure 7.6: Cart Screen

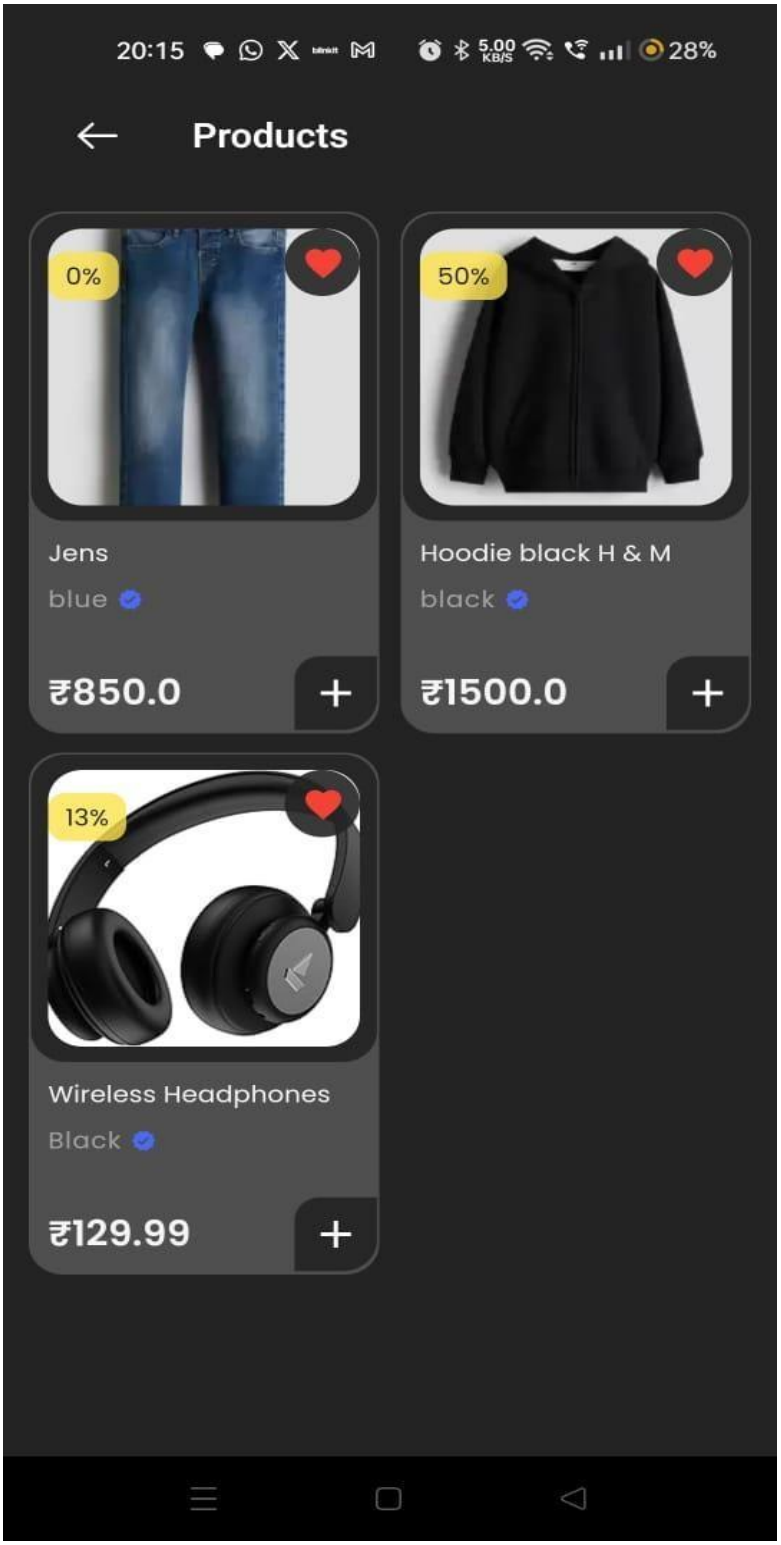

Figure 7.7: Product Screen

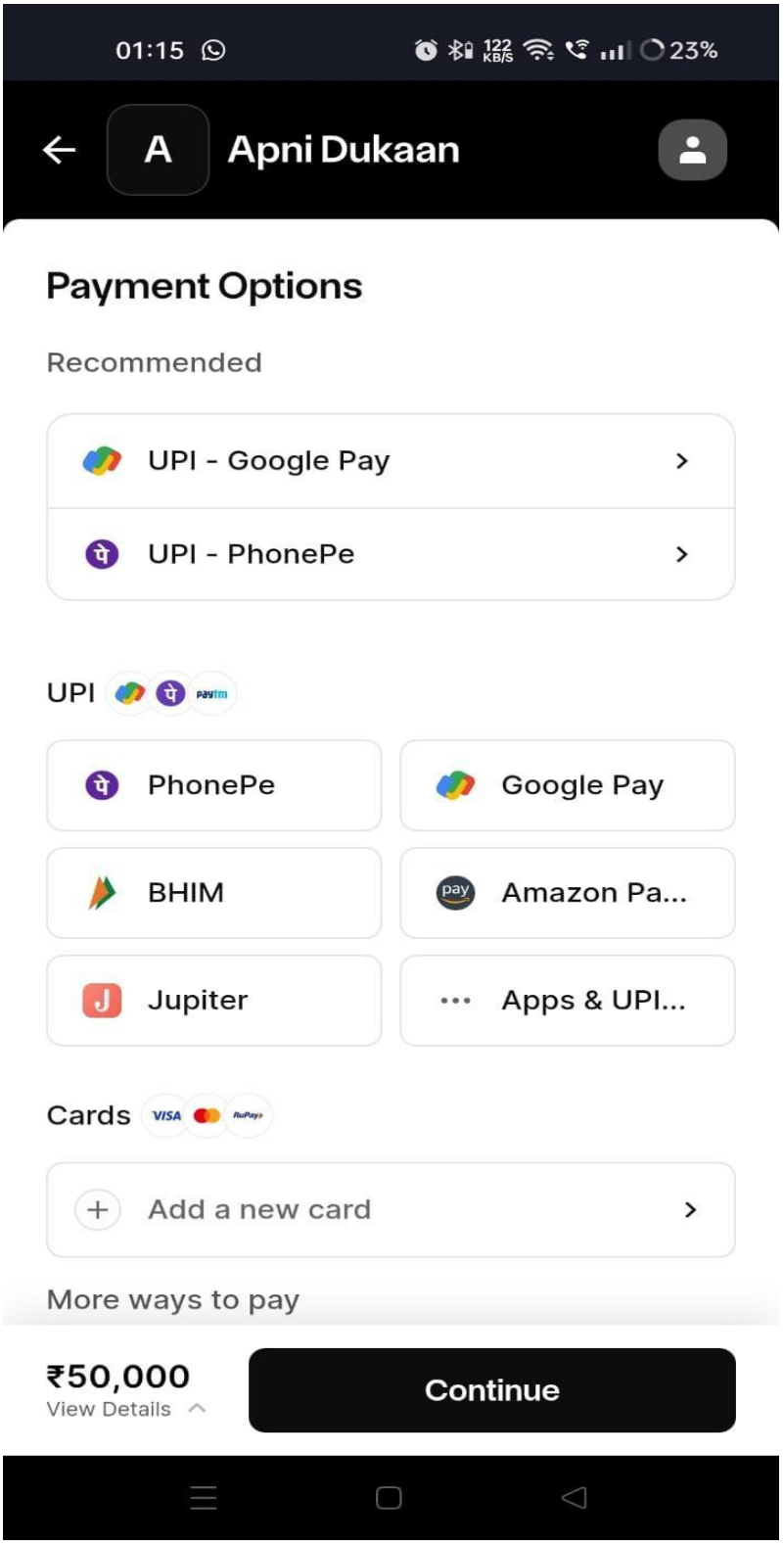

Figure 7.8: Checkout Screen

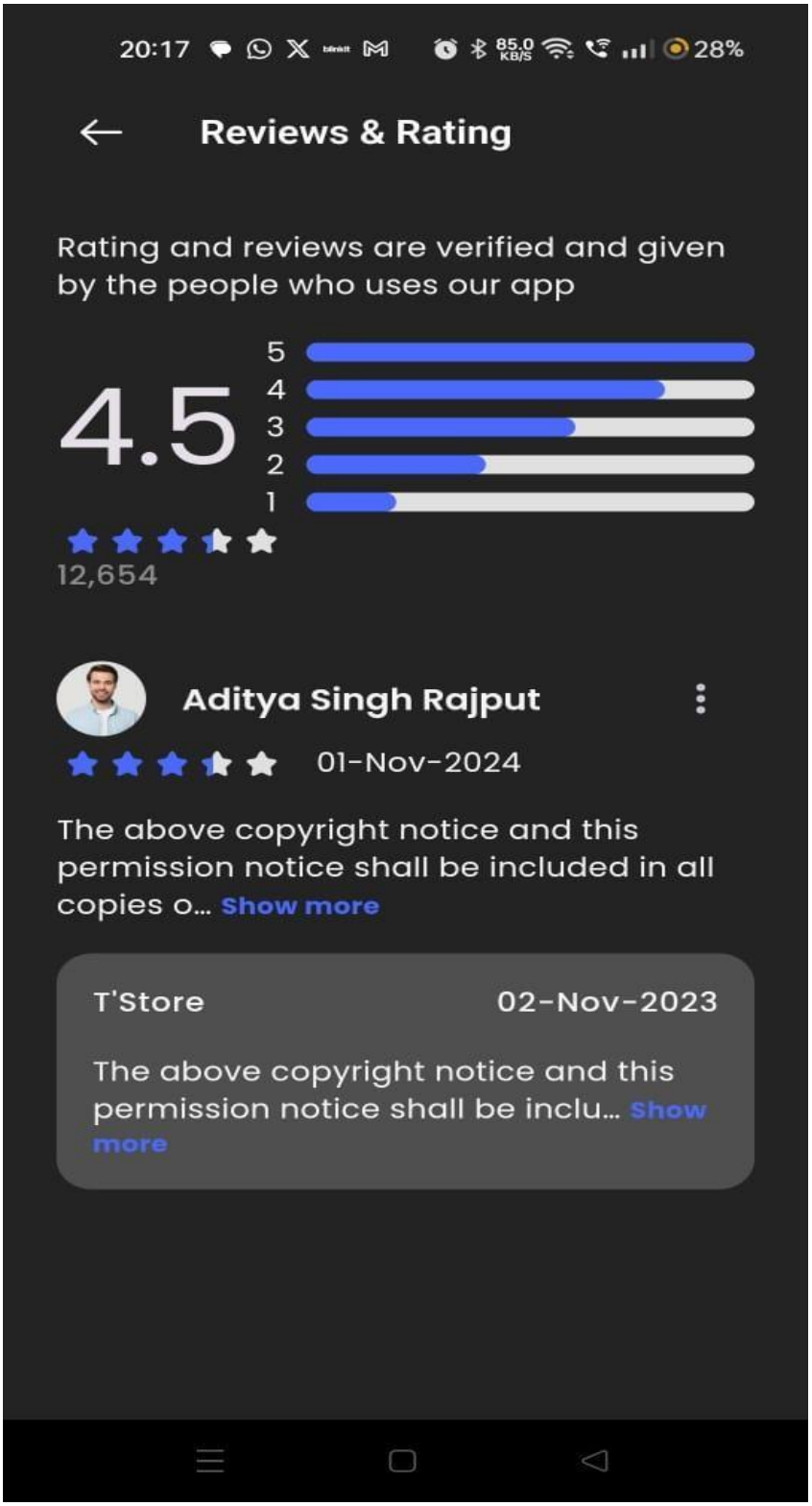

Figure 7.9: Rating Screen

CHAPTER 8
DEPLOYMENT

8.1 INTRODUCTION

This chapter describes how to deploy the project on a fresh machine. It includes Installation steps & snapshots of pre-required software's like Android Studio code. Installation steps & snapshots of the website developed under the minor project. Android Studio is the official Integrated Development Environment (IDE) for Website development software. On top of powerful code editor and developer tools, Android Studio code offers even more features that enhance your productivity when building Website.

8.2 INSTALLATION OF ANDROID STUDIO

Step 1: Head over to https://developer.android.com/studio?gclsrc=ds&gclsrc=dsto get the Android Studio executable or zip file.

Step 2: Click on the **Download Android Studio** Button.

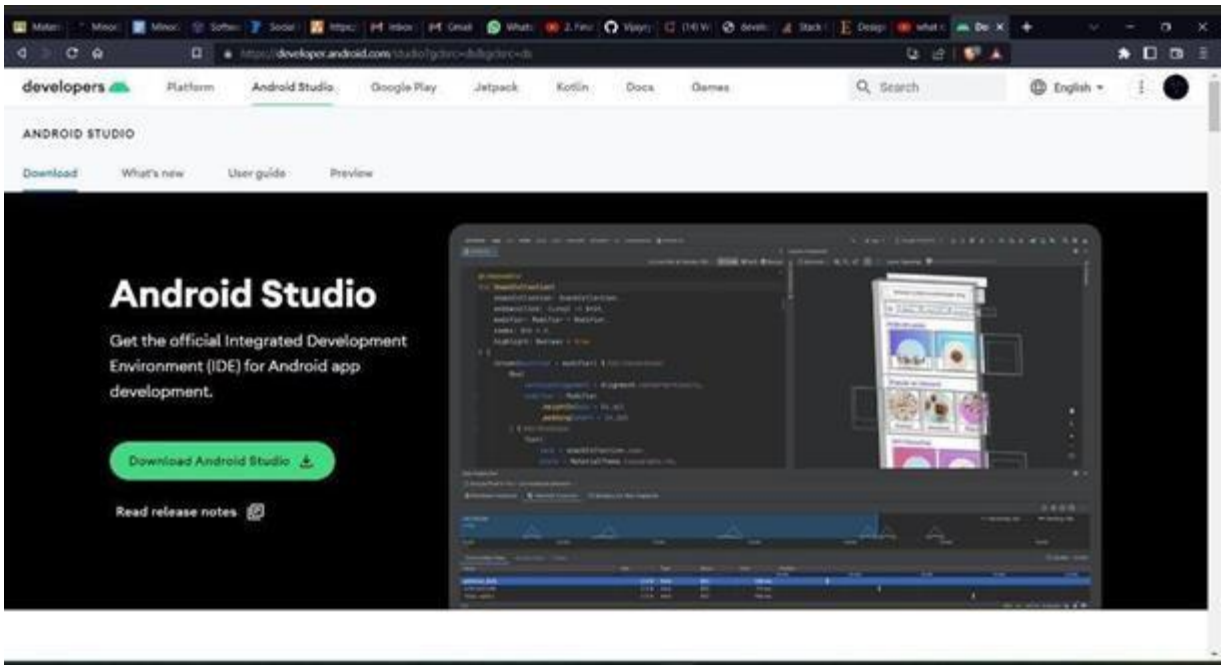

Figure 8.1: Android Studio Installation Window

Click on the "I have read and agree with the above terms and conditions" check box followed by the download button.

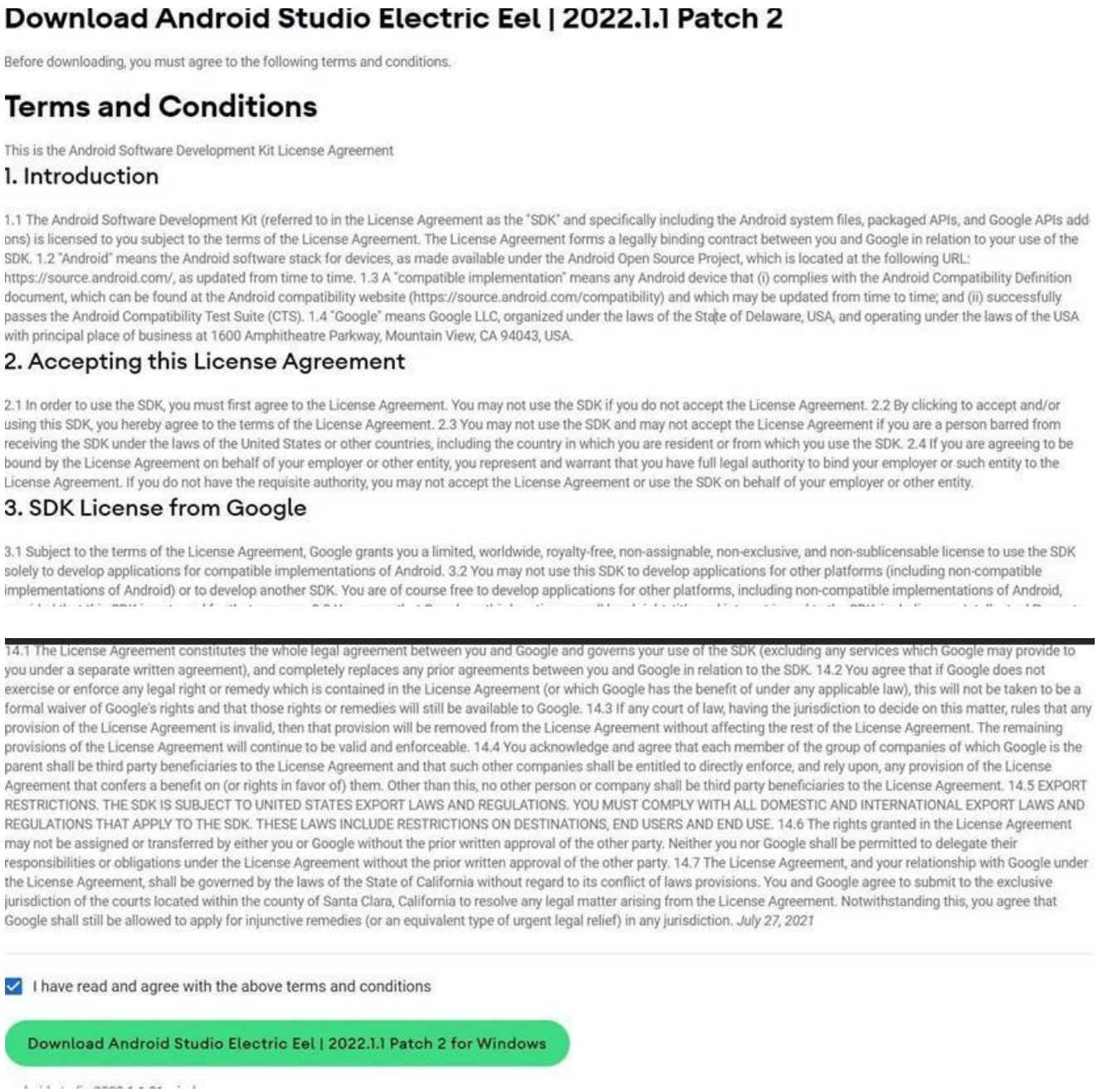

Figure 8.2: Terms & Condition of Android Studio.

Click on the Save file button in the appeared prompt box and the file will start downloading.

Step 3: After the downloading has finished, open the file from downloads and run it. It will prompt the following dialog box.

Figure 8.3: Android Studio Setup

Click on next. In the next prompt, it'll ask for a path for installation. Choose a path and hit next.

Step 4: It will start the installation, and once it is completed, It will be like the image shown below.

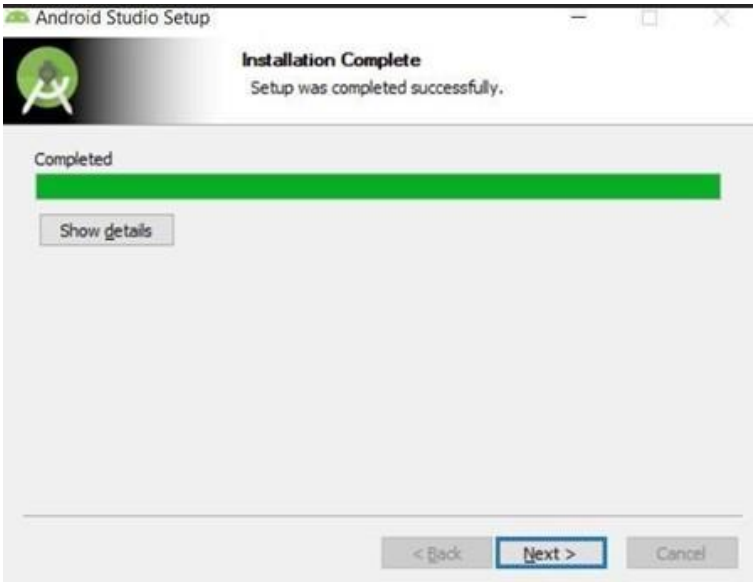

Figure 8.4: Installation Complete

Click on Next.

Figure 8.5: Completing Android Studio Setup

Step 5: Once "**Finish**" is clicked, it will ask whether the previous settings need to be imported [if the android studio had been installed earlier], or not. It is better to choose the 'Don't import Settings option'.

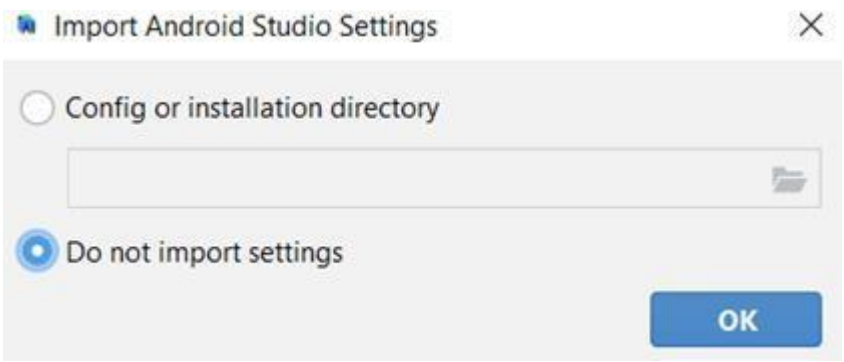

Figure 8.6: Import Location

Click the **OK** button

Step 6: This will start the Android Studio.

Figure 8.7: Starting Android Studio

Meanwhile, It will be finding the available SDK components.

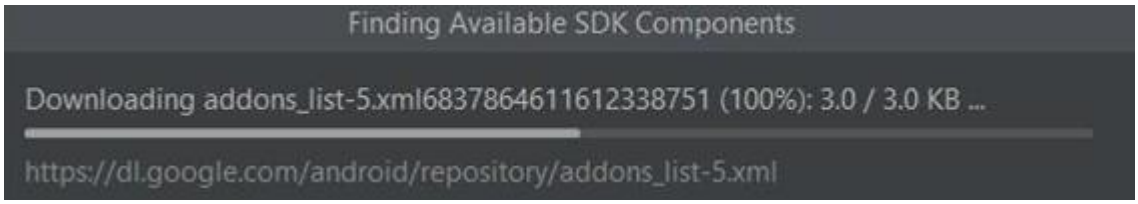

Figure 8.8: Finding Available SDK Components

Step 7: After it has found the SDK components, it will redirect to the Welcome dialog box.

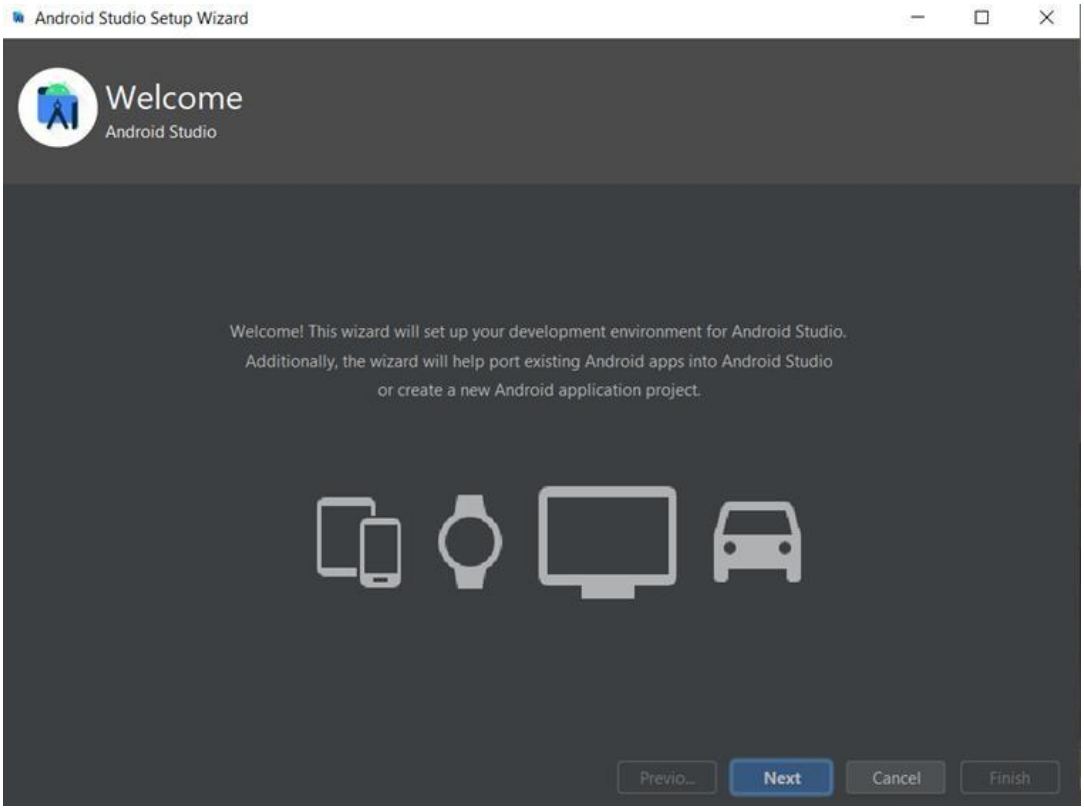

Figure 8.9: Welcome Android Studio

Click on next.

\

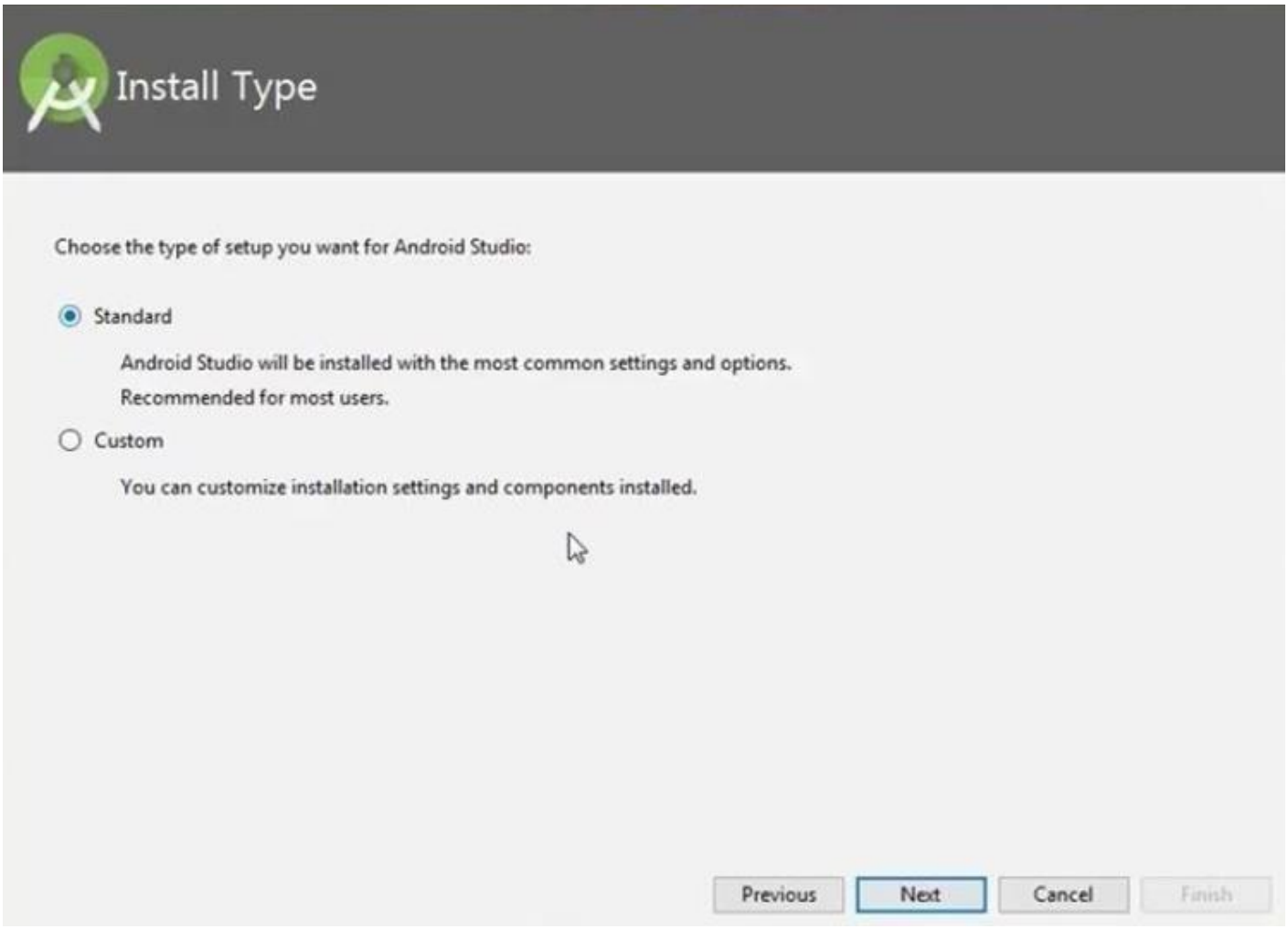

Figure 8.10: Install Type

Choose Standard and click on Next. Now choose the theme, whether the **Light** theme or the **Dark** one. The light one is called the **IntelliJ** theme whereas the dark theme is called **Darcula**. Choose as required.

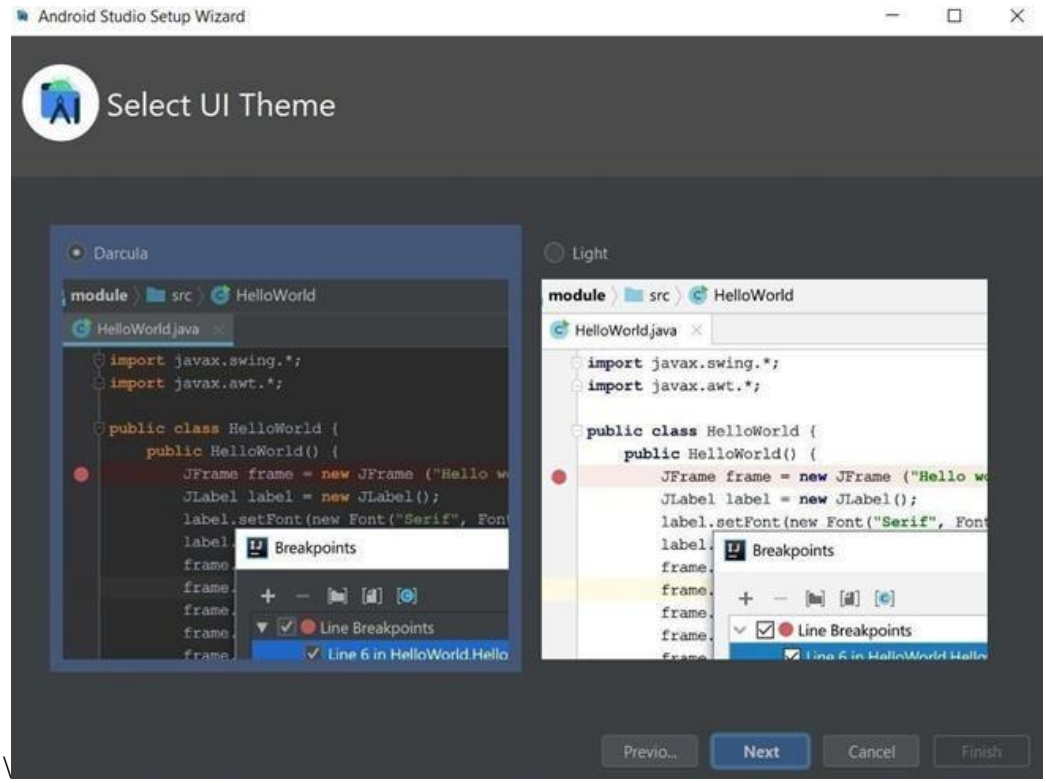

Figure 8.11: Select UI Theme

Click on the **Next** button.

Step 8: Now it is time to download the SDK components.

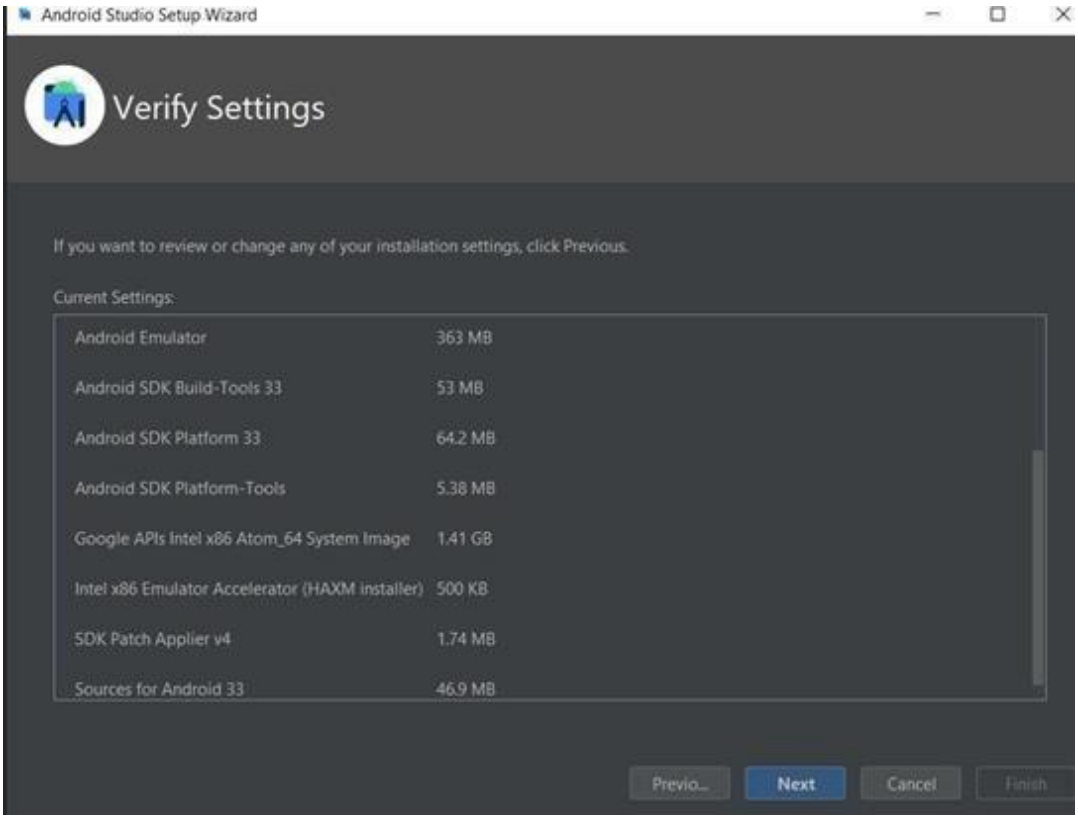

Figure 8.12: Download SDK Components.

Click on Finish .Components begin to download let it complete.

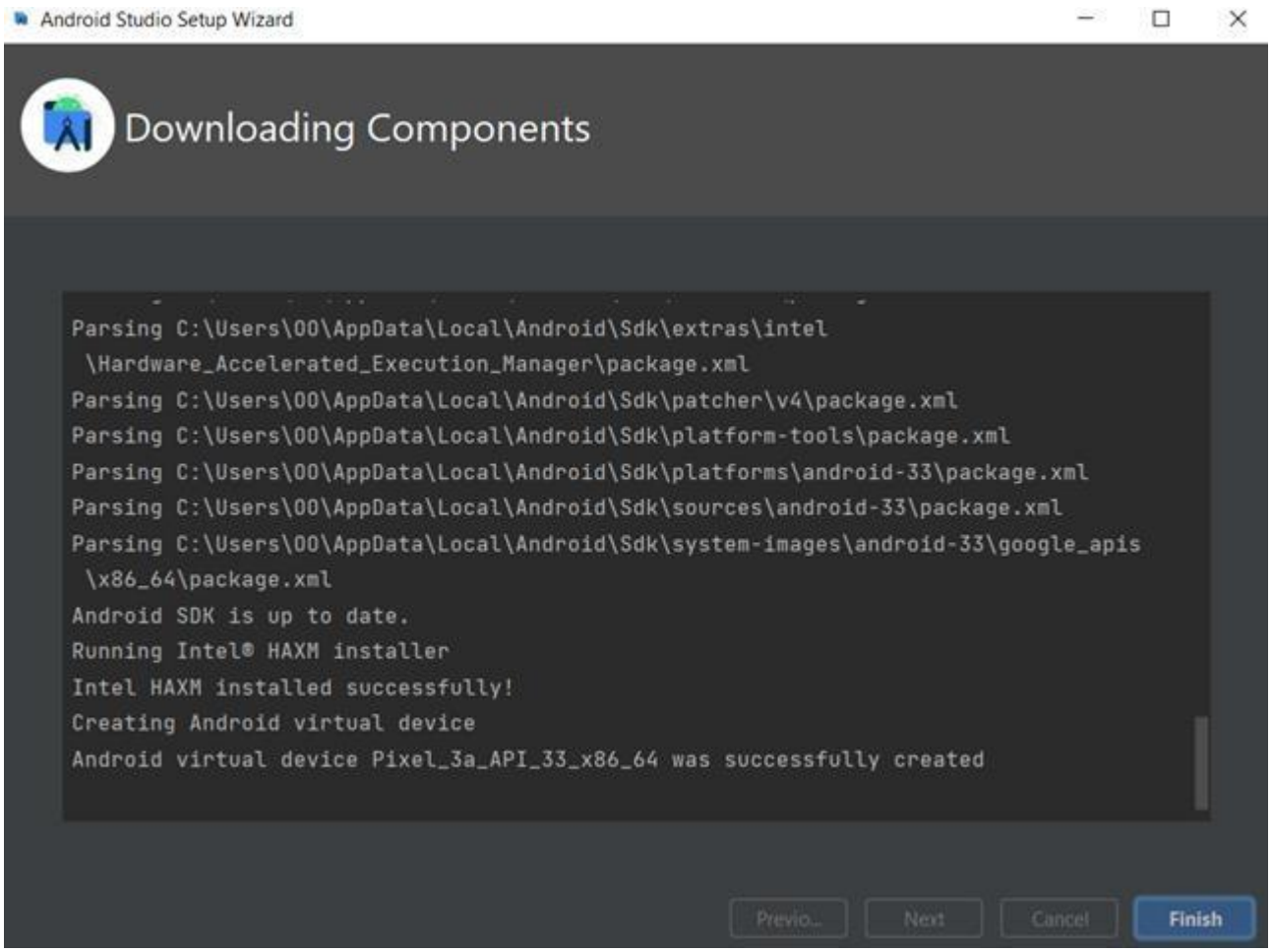

Figure 8.13: Downloading Components

The Android Studio has been successfully configured. Now it’s time to launch and build apps .Click on the Finish button to launch it.

Step 9: Click on **Start a new Android Studio project** to build a new app.

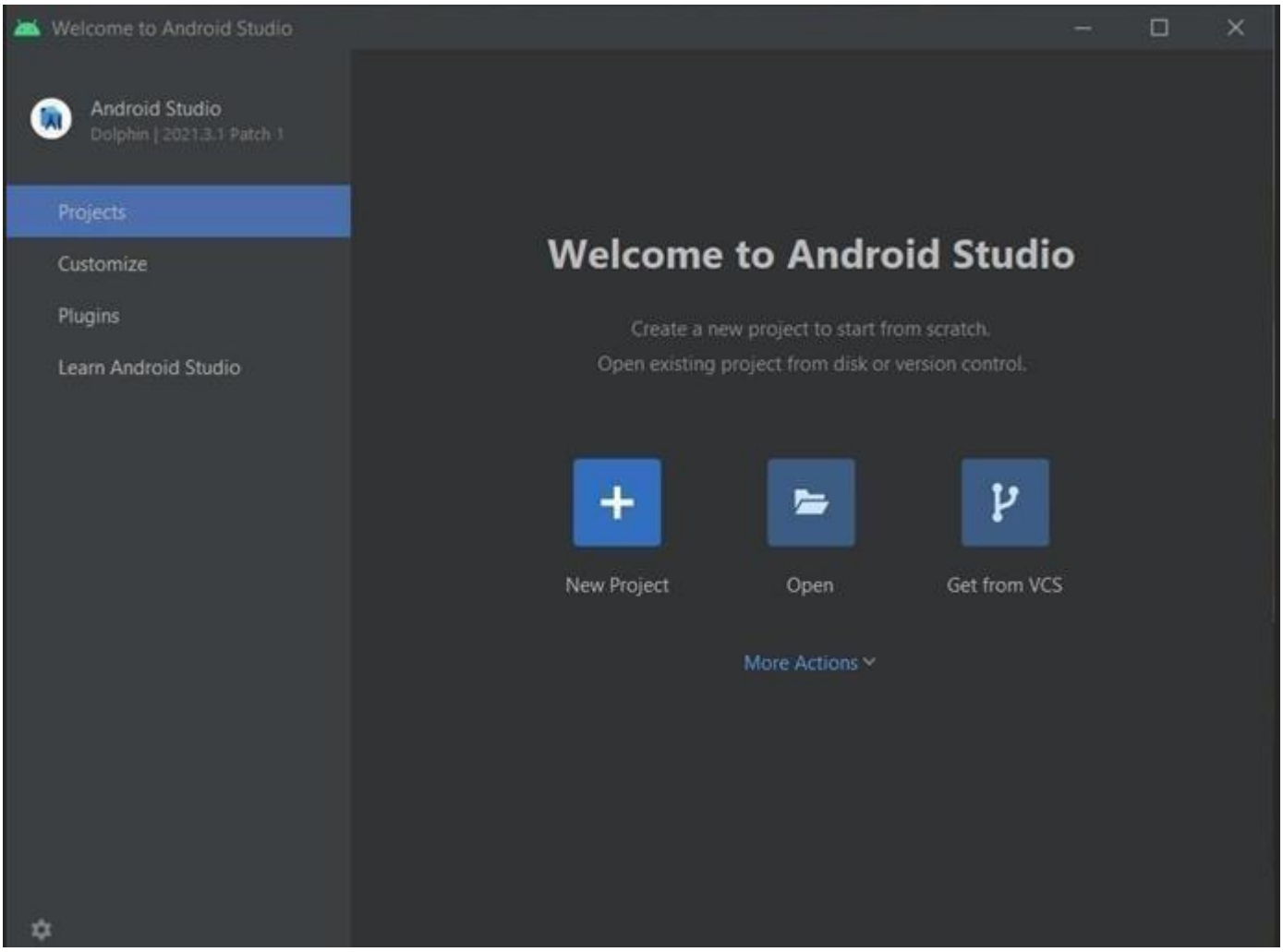

Figure 8.14: Android Studio

CHAPTER 9
CONCLUSION AND FUTURE WORK

9.1 CONCLUSION

The development of this e-commerce platform provides a seamless, efficient, and user-friendly experience for both customers and sellers. By integrating advanced technologies such as Flutter for cross- platform compatibility, Spring Boot for robust backend services, and Postgre SQL for efficient data management, the system ensures high performance, security, and scalability. The platform facilitates secure transactions, personalized recommendations, and a streamlined shopping experience, making online retail more accessible and convenient.

9.2 FUTURE WORK

Looking ahead, several enhancements can be implemented to improve the functionality and effectiveness of the e-commerce system:

9.2.1 Integration with AI-Powered Recommendations:

Leveraging AI and machine learning models to provide personalized product recommendations based on user preferences and browsing history will enhance user engagement and boost sales.

9.2.2 Implementation of Block chain for Secure Transactions: Integrating blockchain technology can enhance payment security, ensuring transparency and reducing fraudulent transactions by creating a decentralized and tamper-proof record of purchases.

9.2.3 Augmented Reality (AR) Shopping Experience: The integration of AR features will allow customers to visualize products in real-world settings before making a purchase, improving customer confidence and reducing return rates.

9.2.4 Chatbot and Virtual Assistance: Implementing AI-powered chatbots for real-time customer support can enhance the user experience by providing instant responses to queries and assisting in product discovery.

9.2.5 Global Expansion and Localization: Enhancing the platform to support multiple languages, currencies, and region-specific features will enable global accessibility and market expansion.

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2. **Gupta, P., & Mehta, S.** (2021) 'Blockchain for Secure E-Commerce Transactions', *International Journal of Advanced Computer Science and Applications (IJACSA)*, Volume 12, Issue 7.
3. **Singh, V., & Reddy, M.** (2024) 'Analyzing Customer Behavior in Online Shopping Using Machine Learning', *Elsevier – Smart Business Technology*, Volume 9.
4. **Patel, D.** (2018) 'A Study on Smart E-Commerce Solutions Using IoT and AI', *International Journal of Engineering & Technology*, Volume 7, Issue 4, pp. 370-373.
5. **Chatterjee, S.** (2022) 'User Experience in E-Commerce: A Comparative Analysis', *IJRASET*, Volume 10, Issue 6.
6. **Vimal, S. P., et al.** (2021) 'Recommendation Systems in E-Commerce: A Data-Driven Approach', *Journal of Computer Science Research*, Volume 1917, Article Number 012028.
7. **Jain, R., & Kulkarni, S.** (2016) 'Impact of Mobile Shopping on Consumer Behavior', *International Research Journal of Engineering and Technology (IRJET)*, Volume 03, Issue 04.

WEBSITES (with exact URL up to page)

8. https://www.statista.com/statistics/e-commerce-growth-trends
9. https://www.forbes.com/sites/ecommerce-trends-2024
10. https://www.shopify.com/blog/ecommerce-trends

PROJECT SUMMARY

About Project

Title of the project	E Commerce Mobile Application
Semester	8th
Members	Aditya Singh, Amit Pandey, Laveena Pahuja, Prafull Raghuwanshi
Team Leader	Aditya Singh Rajput
Describe role of every member in the project	Aditya Singh Rajput: Backend Amit Pandey : Frontend Laveena Pahuja: Prototyping Prafull Raghuwanshi: Frontend and designing
What is the motivation for selecting this project?	The project aims to enhance e-commerce efficiency by ensuring secure transactions, seamless order processing, and a user-friendly experience. It focuses on cost-effectiveness, scalability, and reliability for businesses and customers.
Project Type (Desktop Application, Web Application, Mobile App, Web)	Mobile Application

Tools & Technologies

Programming language used	Java (Spring Boot 3.2)
Compiler used (with version)	AndroidStudioLadybug|2024.2.1
IDE used (with version)	AndroidStudioLadybug|2024.2.1
Front End Technologies(with version, wherever Applicable)	Flutter3.24.0
Back End Technologies(with version, wherever applicable)	Spring Boot 3.2
Database used (with version)	PostgreSQL17

Software Design & Coding

Is prototype of the software developed?	Yes
SDLC model followed (Waterfall, Agile, Spiral etc.)	Prototype
Why above SDLC model is followed?	The Prototype model was chosen for this project to facilitate early user feedback and requirement validation through iterative development. This approach allows for a clearer understanding of user needs by creating functional prototypes, ensuring the final product aligns closely with expectations.
Justify that the SDLC model mentioned above is followed in the project.	Changing Requirement, Client Involvement, Iterative Development, Early Delivery of Value, Adaptability, Collaborate Team Environment, Continuous Testing, Risk Management, Customer Satisfaction.
Software Design approach followed (Functional or Object Oriented)	Object-Oriented Approach
Name the diagrams developed (According to the Design approach followed)	Use Case Diagram
In case Object Oriented approach is followed, which of the OOPS principles are covered in design?	1. Encapsulation 2. Abstraction 3. Inheritance 4. Polymorphism 5. Composition
No. of Tiers (example3-tier)	3-tier
Total no. of front-end pages	5
Total no. of tables in database	3
Database in which Normal Form?	3NF
Are the entries in database encrypted?	Yes
Frontend validations applied (Yes / No)	Yes
Session management done (in case of web applications)	No
Is application browser compatible (in case of web applications)	No
Exception handling done (Yes / No)	Yes

Commenting done in code (Yes / No)	Yes
Naming convention followed (Yes / No)	Yes
What difficulties faced during deployment of project?	-
Total no. of Use-cases	5
Give titles of Use-cases	Use Case Diagram

Project Requirements

MVC architecture followed (Yes / No)	Yes
If yes, write the name of MVC architecture followed (MVC-1,MVC-2)	MVC-2
Design Pattern used (Yes / No)	No
If yes, write the name of Design Pattern used	-
Interface type(CLI/GUI)	GUI
No. of Actors	3
Name of Actors	1. Admin 2. User 3. Super Admin
Total no.of Functional Requirements	3
List few important non-Functional Requirements	1. Scalability 2. Reliability 3. Data Security 4. Performance 5. Usability 6. Maintainability 7. Cost-Effectiveness 8. Compliance

Testing

Which testing is performed? (Manual or Automation)	Both Manual Testing and Automation Testing
Is Beta testing done for this project?	No

Write project narrative covering above mentioned points

The **E-Commerce Mobile Application** provides a seamless and efficient platform for online shopping. It enables users to browse, search, and purchase products effortlessly while ensuring a secure and user-friendly experience. The application features real-time inventory management, secure payment gateways, and personalized recommendations. A responsive mobile interface ensures smooth navigation, order tracking, and instant notifications. Secure authentication, end-to-end encryption, and role-based access control protect user data. Designed with scalability and cost- effectiveness in mind, the system supports high-traffic loads and multiple vendors. With 99.9% uptime and fast processing, it guarantees reliable performance. The application is accessible across diverse languages, compliant with regional regulations, and maintains detailed transaction logs for analysis, empowering businesses to enhance customer engagement and sales efficiently.

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Amit Pandey	0187CS211025
Laveena Pahuja	0187CS211090
Prafull Raghuwanshi	0187CS201120

Guide Signature
Dr. Komal Tahiliani

APPENDIX-1 GLOSSARY OF TERMS

(In alphabetical order)

A: Acronyms and Terminology

- **API**: Application Programming Interface
- **UI/UX**: User Interface / User Experience
- **SSL**: Secure Sockets Layer (used for secure transactions)
- **CRM**: Customer Relationship Management (used for managing customer interactions
- **Payment Gateway:** A service that authorizes and processes online payments securely

B: Backend and Cloud Infrastructure

- **Platform:** The backend is built using Spring Boot for scalability and Postgre SQL for secure data storage. Cloud hosting services like AWS or Aiven Cloud ensure high availability and reliability.
- **Data Management:** The system efficiently manages user data, order history, and inventory using Postgre SQL, ensuring fast retrieval and high security.
- **APIs and Libraries:** The application integrates with payment gateways (Razor pay, Stripe, PayPal), Google Maps API for location-based services, and third-party authentication providers like Google and Facebook for secure logins.

C: Challenges and Solutions

- **Real-time Inventory Management:** Synchronizing stock levels across multiple vendors was addressed using event-driven architecture and Web Sockets for real-time updates.
- **Secure Transactions:** Implemented SSL encryption and multi-layer authentication to prevent fraud and unauthorized access.
- **Scalability:** Optimized database queries, used caching mechanisms (Redis), and ensured micro services-based architecture to handle high traffic loads efficiently.