Sneaker Thesis Book Final

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Sneaker Vision

Final Year Project Report

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This project "**Sneaker Vision**" is presented by **Muhammad Rizwan, Abdul Basit Abbasi & Minahil Khan** under the supervision of their project advisor and approved by the project examination committee, and acknowledged by the Hamdard Institute of Engineering and Technology, in the fulfillment of the requirements for the **Bachelor degree of Computer Science**.

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Authors' Declaration

We declare that this project report was carried out in accordance with the rules and regulations of Hamdard University. The work is original except where indicated by special references in the text and no part of the report has been submitted for any other degree. The report has not been presented to any other University for examination.

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Plagiarism Undertaking

We, **Muhammad Rizwan, Abdul Basit Abbasi & Minahil Khan**, solemnly declare that the work presented in the Final Year Project Report titled Sneaker Vision has been carried out solely by ourselves with no significant help from any other person except few of those which are duly acknowledged. We confirm that no portion of our report has been plagiarized and any material used in the report from other sources is properly referenced.

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Definition of Terms, Acronyms, and Abbreviations

Table 2: Definition of Terms, Acronyms, and Abbreviations

Term	Description
App	Application
ARKit	Augmented Reality Kit
AR Core	Augmented Reality Core
PCI DSS	Payment Card Industry Data Security Standard.
GDPR	General Data Protection Regulation
CCPA	California Consumer Privacy Act

Abstract

Sneaker Vision is a cutting-edge online marketplace designed to revolutionize the way sneaker enthusiasts buy, sell, and interact. With the rapid growth of e-commerce and the increasing demand for convenience in shopping experiences, Sneaker Vision leverages innovative technology to bridge the gap between physical and virtual shopping. The platform addresses critical challenges faced by users, such as time-consuming searches, inaccurate product representations, and sizing issues, by incorporating advanced features like augmented reality (AR) technology, a comprehensive product catalog, and seamless communication tools forthe sneaker community.

At the heart of Sneaker Vision is its augmented reality feature, which allows users to virtually try on sneakers using ARKit (iOS) and ARCore (Android). This eliminates uncertainty about fit and appearance, providing an immersive, accurate preview of the product. The platform also boasts an intuitive user interface that streamlines the shopping process, from registration to checkout. Features include robust search capabilities, a dynamic catalog with detailed product information, a secure payment gateway, and options to leave feedback and ratings.

Sneaker Vision enhances user engagement by fostering a vibrant community of sneaker enthusiasts. Users can interact, share reviews, and participate in bidding processes for rare and exclusive sneaker collections. The platform also ensures a secure and scalable architecture, incorporating compliance with GDPR, PCI DSS, and CCPA standards to safeguard user data and financial transactions.

This project aims to create a seamless, user-friendly platform that not only simplifies the process of finding the perfect sneakers but also builds a sense of community among sneaker lovers worldwide. With its innovative features, Sneaker Vision positions itself as a transformative solution in the e-commerce landscape, delivering an unparalleled shopping experience that combines technology, convenience, and style.

Keywords:

Sneaker, Augmented Reality (AR), E-commerce Platform, Sneaker Community, Secure Payment Gateway, ARKit, ARCore, User-Friendly Interface, Product Catalog, Online Shopping, Size Accuracy, Sneaker Enthusiasts, Customer Engagement, Feedback and Ratings, Data Privacy Compliance, Scalable Architecture, Exclusive Sneakers

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CHAPTER 1

INTRODUCTION

1.1 Motivation

The inspiration behind **Sneaker Vision** stems from the growing demand for a seamless and reliable online shopping experience tailored to sneaker enthusiasts. In the modern e-commerce landscape, customers often face challenges such as the inability to physically try on products, discrepancies between product images and the actual item, and limited access to rare or exclusive sneakers. These pain points not only reduce customer satisfaction but also lead to frequent returns and wasted time, creating a gap that traditional online platforms fail to address. With the increasing popularity of augmented reality (AR) technology and its ability to provide immersive experiences, Sneaker Vision aims to leverage this innovation to bridge the gap between physical and online shopping. By integrating AR for virtual try-ons, Sneaker Vision empowers users to visualize how sneakers fit and look in real-time, significantly reducing sizing issues and increasing confidence in purchases. The motivation behind this project is to create a revolutionary platform that combines technology, convenience, and community to enhance the overall shopping experience for sneaker lovers. Sneaker Vision is designed to provide solutions that save time, build trust, and deliver value, ultimately positioning itself as the go-to platform for sneaker enthusiasts worldwide.

1.2 Problem Statement

Our product is a solution to those who wish to save time and not spend hours at the shopping center looking for ideal shoes. We had the idea of improving the online shoe shopping experience because we know that most people who buy shoes online tend to have a problem with sizing and also with differences between the picture and the item itself. Our app, SneakerVision, provides a cutting-edge solution by enabling users to try on shoes virtually with augmented reality technology. This will not only conserve users' time and effort, but also give them a better preview of the actual look and fit of the shoes, and ultimately contribute to a more satisfactory and convenient shopping experience.

1.3 Goals and Objectives

- To make the user experience more convenient by eliminating the need for physical visits to the shoe stores.
- Utilize augmented reality (AR) to provide accurate virtual try-ons for confident purchasing decision.
- To provide a reliable preview of how the shoes will look on one’s feet without the hassle of visiting stores.
- To enhance the user experience by providing a user-friendly design, easy navigation and a full-flex mobile application.
- Collaborate with retailer to boost sales through innovate shopping experience.

1.4 Project Scope

- User registration and login.
- Browse and search for sneakers.
- Catalog of available shoes with product details and images
- Integration of augmented reality technology to allow users to try on shoes virtually.
- Add sneakers to a cart and purchase them through the app.
- Payment Gateway Integration.
- User feedback and ratings system.
- The admin should be able to manage users' accounts, including creating new accounts, updating user information, and deleting user accounts.

CHAPTER 2

2.1 RELEVANT BACKGROUND & DEFINITIONS

Sneaker Vision is imagined to be a solution to the problems encountered by sneaker aficionados within the e-commerce landscape. Sneaker culture over the last decade has exploded, driven by limited releases, collaborations with elite brands, and a lively secondary market. Conventional methods of shopping tend to overlook the particular requirements of sneakerheads, such as access to special collections, proper size and fit, and a secure buying environment.

The utilization of augmented reality (AR) in online shopping sites is transforming the manner in which consumers engage with products. AR technology allows one to view and manipulate virtual objects in his/her own environment, and hence it is a perfect fit for addressing size and look issues. Through the use of ARKit (iOS) and ARCore (Android), Sneaker Vision makes it possible for consumers to try on sneakers virtually, closing the gap between online and offline shopping.

Definitions:

- **Augmented Reality (AR):** A technology that overlays virtual objects onto the real world using a device's camera and sensors. In Sneaker Vision, AR enables virtual try-ons for sneakers.
- **Virtual Try-On:** A feature allowing users to visualize how a product (e.g., sneakers) will look on them in real time using AR technology.
- **ARKit and ARCore:** Software development kits by Apple and Google, respectively, that enable AR functionality on iOS and Android devices.
- **Payment Gateway:** A secure online mechanism for processing payments during e-commerce transactions.
- **User Feedback System:** A platform feature that allows customers to rate products and share reviews, enhancing trust and transparency.

CHAPTER 3

3.1 LITERATURE REVIEW & RELATED WORK

Sneaker Vision's concept is grounded in the growing trends of augmented reality in e-commerce and the increasing consumer demand for seamless, interactive, and accurate online shopping experiences. The use of AR technology in retail has been widely researched, with studies indicating its effectiveness in reducing purchase uncertainty and enhancing customer satisfaction. Additionally, literature on sneaker culture highlights the importance of exclusivity, authenticity, and community engagement as key drivers of consumer behavior in this niche.

1. Augmented Reality in E-commerce
Research by Schmalstieg and Hollerer (2016) in "Augmented Reality: Principles and Practice" demonstrates the potential of AR to bridge the gap between physical and online shopping experiences. AR's ability to provide real-time visualization of products in the user's environment is a key factor in reducing return rates and increasing consumer confidence.

2. Sneaker Market Trends
Market reports, such as those by Statista and IBISWorld, have documented the explosive growth of the sneaker industry, particularly driven by collaborations, limited-edition drops, and the secondary market. These studies emphasize the need for platforms that cater to the unique demands of sneakerheads, including access to exclusive products and a trusted marketplace.

3. Community-Driven Commerce
Studies on social commerce and community-driven platforms, such as eBay and StockX, reveal that creating a sense of belonging and trust through user engagement and transparency significantly impacts customer loyalty and platform success.

3.2 Related Work

1. StockX
A well-known online marketplace for sneakers, StockX uses a stock market-like bidding process for buying and selling. It emphasizes authentication and exclusivity but lacks AR integration for virtual try-ons.

2. GOAT
GOAT offers a diverse catalog of sneakers with user ratings and community features. However, its focus is more on resale rather than enhancing the shopping experience through advanced technologies like AR.

3. Nike's Augmented Reality Try-On Feature
Nike has implemented AR features in its app for virtual try-ons, showcasing the growing trend of AR in the sneaker market. However, this feature is brand-specific and does not cater to a broader marketplace.

4. Zappos
Zappos provides a large catalog with a focus on customer service and detailed product

information but lacks the niche focus and AR functionality Sneaker Vision offers.

3.3 Gap Analysis

Despite the progress in e-commerce and AR technologies, significant gaps remain:

1. Lack of AR Integration in Marketplaces

While some platforms (e.g., Nike) use AR for virtual try-ons, these solutions are limited to specific brands. No major marketplace integrates AR across multiple brands and sellers, leaving a gap in the broader application of this technology.

2. Unified Community Engagement and Marketplace

Existing platforms often separate community features (e.g., reviews, forums) from the buying process, failing to create an integrated ecosystem for sneakerheads to interact and transact seamlessly.

3. Sizing and Fit Challenges

Current marketplaces struggle to address the common issue of inconsistent sizing and fit when purchasing sneakers online. AR technology remains underutilized in solving this problem.

4. Limited Transparency in the Secondary Market

Trust is a significant concern in the sneaker resale market, as buyers are often wary of counterfeit products. A unified platform with authentication and user feedback mechanisms is needed.

CHAPTER 4
PROJECT DISCUSSION

4.1 Software Engineering Methodology

The software development approach utilized for the SneakerVision system is the Prototype Model, due to its suitability in projects where the requirements are at first ambiguous or changeable. SneakerVision sought to implement novel features such as augmented reality (AR) virtual try-ons, which needed ongoing user input to make improvements. In order to better tackle this, an early working prototype was created, highlighting essential functionality like sneaker browsing, product detail views, and a reduced AR experience. This enabled stakeholders and potential users to engage with the system and offer critical feedback. Through this feedback, the development team iteratively refined the design, functionality, and UI of the application. The Prototype Model also mitigated the risk of developing a product that wasn't in accordance with user requirements, made it possible to achieve greater requirements clarity, and improved overall usability—particularly with the intricate integration of AR. All in all, it facilitated the conversion of SneakerVision from an idea into a user-centered, feature-rich app designed specifically for contemporary sneaker consumers.

4.2 Project Methodology

Prototype Model Project Approach

- **Early Functional System**: Focus on creating an initial version of the system to gather user feedback and refine requirements.
- **Preliminary Requirements**: Identify and prioritize initial requirements to design a quick prototype.
- **User Interaction**: Allow users and stakeholders to interact with the prototype to gather feedback on functionality, usability, and design.
- **Iterative Improvements**: Refine the prototype based on feedback through multiple iterations to align with user needs.
- **Validation and Development**: Use the validated prototype as a blueprint to develop the final system.
- **Innovation Testing**: Ideal for innovative projects like SneakerVision, where features such as AR and virtual try-ons require user-centric evaluation.
- **Risk Minimization**: The iterative process helps identify and mitigate risks early in development.
- **Enhanced Collaboration**: Encourages teamwork among stakeholders to ensure the product meets expectations.

- **User Satisfaction**: Ensures the final product delivers a seamless and user-friendly experience.

4.3 Phases of Project

The SneakerVision project was divided into the following well-defined phases:

- **Requirement Analysis**:
  In this initial phase, developers worked closely with stakeholders to gather and understand the core requirements, especially regarding online shopping pain points and the need for AR integration.

- **Prototype Design**:
  A functional prototype was built, focusing on user interaction, sneaker browsing, and basic AR preview functionality to showcase the application's vision.

- **User Feedback and Evaluation**:
  Stakeholders and users tested the prototype and shared feedback on usability, features, and performance.

- **System Design & Development**:
  Based on the feedback, the complete system was designed, and detailed development began, incorporating all essential features such as virtual try-ons, payment gateway, user profile, and feedback systems.

- **Testing**:
  Rigorous testing was carried out to ensure functionality, AR accuracy, performance, and security, especially in the shopping and payment modules.

- **Deployment and Maintenance**:
  After testing, the application was deployed, and ongoing maintenance is performed to update sneaker catalogs, AR models, and user support systems.

4.4 Software/Tools that Used in Project

These technologies and tools collectively enable the development team to create a robust, visually appealing, and user-friendly front end for this Software platform.

- **Flutter (Dart):**
  It is an open-source UI software development toolkit created by Google, and it was used as the primary framework for developing the SneakerVision mobile application.

- **Firebase:**
  It's a Backend-as-a-Service (BaaS) platform by Google, was used to handle various backend services of the application. It supported user authentication, cloud storage, real-time database for syncing product catalogs and user data, push notifications, and analytics.

- **Visual Studio Code:**
  VS Code served as the main code editor for the development team. It provided a lightweight yet powerful environment for writing and debugging Dart code.

- **Figma**
  It was the design tool used for creating the UI/UX of SneakerVision. It enabled the design team to collaborate in real-time while crafting wireframes, mockups, and interactive prototypes.

- **DeepAR:**
  It was used to implement the Augmented Reality (AR) functionality in SneakerVision. This SDK specializes in real-time AR experiences and provided the core capability for users to virtually try on sneakers using their smartphone camera.

4.5 Hardware that Used in Project

HP Laptop

- Laptop with Internet Connectivity.
- Wireless Mouse.
- USB

1

System Requirements

- Operating System: Microsoft Windows 10.
- CPU Type: Intel® Core (TM) i5-4300 U CPU @2.32GHz 2.40GHz
- Memory: 8GB/ Disk Space: 120 SSD 320 HDD

Chapter 5
IMPLEMENTATION

5.1 Proposed System Architecture/Design

The system architecture for SneakerVision is designed to provide a seamless, efficient, and scalable online marketplace experience. It is divided into several layers, each with specific responsibilities to ensure smooth functionality and interaction between components. Below is an outline of the architecture:

- **Client Layer (Frontend)**
- Components: Mobile application (iOS and Android), Web interface.
- Technology: React Native for mobile apps, React.js or similar framework for web.
- Responsibilities:
    - Provides an intuitive user interface for registration, browsing sneakers, and virtual try-on functionality.
    - Enables users to add sneakers to the cart, manage profiles, and interact with the community.
    - Communicates with backend services via APIs for data retrieval and submission.
    - Implements the augmented reality (AR) feature using SDKs like ARKit (iOS) and ARCore (Android).

- **Application Layer (Backend)**
- Components: Server-side application hosted on a cloud platform.
- Technology: Python, Dart.
- Responsibilities:
    - Manages business logic, including user authentication, profile management, and AR processing.
    - Handles requests from the frontend and retrieves or updates data in the database.
    - Ensures smooth functionality for virtual try-on, bidding procedures, and user feedback.
    - Provides APIs for frontend communication.

- **Database Layer**
- Components: Relational database Firebase.
- Responsibilities:
    - Stores user data, including login credentials, profiles, and transaction history.
    - Maintains sneaker catalog details, including product images, descriptions, and AR models.
    - Logs user interactions and feedback for analysis and future improvements.

- **Augmented Reality (AR) Layer**
- Components: AR SDKs (e.g., ARKit, ARCore) and 3D model storage.
- Responsibilities:
    - Processes and renders AR visualizations for virtual try-ons.

- Ensures accurate scaling and alignment of 3D sneaker models with user foot dimensions.
- Updates AR models based on catalog changes or new product additions.

- **Payment Gateway Integration**
- Components: Secure third-party payment services (e.g., Stripe, PayPal).
- Responsibilities:
  - Facilitates secure transactions for sneaker purchases.
  - Ensures compliance with PCI DSS standards for payment data protection.
- Supports multiple payment methods, including credit/debit cards and digital wallet.

.1.1 Proposed System Architecture/Design

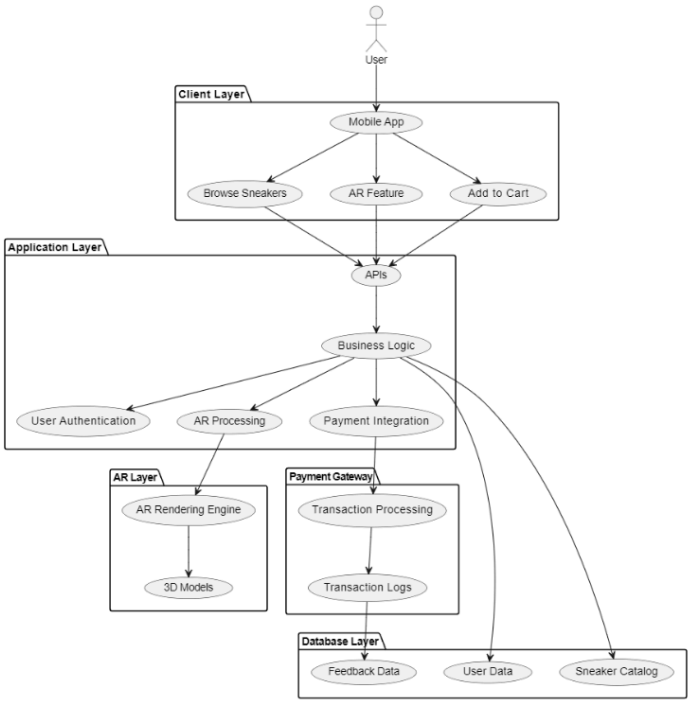

Figure 1: System Level Architecture

1. **Client Layer**: Users access the system via the web interface or mobile app, which allows browsing sneakers, utilizing AR functionality, and adding items to the cart.
2. **Application Layer**: This layer includes APIs for communication between the client and backend, and handles core functionalities like user authentication, AR processing, and payment integration.
3. **AR Layer**: Features an AR rendering engine for displaying 3D sneaker models and managing augmented reality experiences.
4. **Payment Gateway**: Ensures secure transactions with features like transaction processing and maintaining transaction logs.
5. **Database Layer**: Stores user profiles, sneaker catalog details, and feedback data, while supporting data flow and processing through the business log

5.2 Functional Specifications

The **SneakerVision** mobile application is designed to revolutionize the way sneaker enthusiasts buy and experience sneakers online. The following functional specifications define the key features and system behavior from the user's perspective:

- **User Registration and Login**

- Users can create an account using an email and password.
- Firebase Authentication handles secure login, logout, and password recovery functionalities.
- User session persists until manually logged out.

- **User Profile Management**

- Each user profile maintains a history of previous orders and interactions.
- Passwords can be updated through Firebase secure reset mechanisms.

- **Sneaker Catalog Browsing**

- Product pages display detailed information including multiple images, available sizes, descriptions, and user ratings.
- Users can search for sneakers using a keyword-based search bar with filters and sorting options.

- **Augmented Reality Try-On (AR)**

- Using the smartphone camera, users can preview how selected sneakers will look on their feet using AR technology powered by DeepAR SDK.
- Real-time 3D tracking ensures accurate fitting visualization.
- Users can switch between different sneakers to compare styles directly in AR view.

- **Shopping Cart and Checkout**

- Users can add selected sneakers to their cart.
- The cart displays item name, size, price, and quantity.
- Users can update quantities or remove items before checkout.

- **Payment Integration**

- The app integrates with Stripe or PayPal to allow secure and seamless payments.
- Users receive in-app confirmation and email receipts after successful transactions.
- Payments are encrypted and comply with standard security protocols.

- **Order Management**

- Users can view a list of all past orders, along with order details and statuses (Processing, Shipped, Delivered).
- Each order includes invoice number, date, delivery address, and order summary.

- **Ratings and Reviews**

- Ratings help future users evaluate product quality and fit.
- Admin visibility allows inappropriate reviews to be flagged and removed.

- **Admin-Free Operation**

- The system does not involve direct admin panel controls; all functionality is automated or handled by Firebase backend services (authentication, data handling).
- The system is designed to be user-managed, reducing dependency on admin involvement.

5.3 Non-Functional Specifications

Non-functional specifications define the overall qualities and constraints of the SneakerVision system, ensuring it is usable, reliable, and scalable. These attributes support the core functionality while enhancing user experience, performance, and maintainability.

- **Performance Requirements**

- The application should load sneaker catalogs and product pages within 2–3 seconds.
- AR visualization should activate in under 3 seconds with smooth real-time rendering at a minimum of 30 FPS.
- System response time for user actions (e.g., login, adding to cart, payment) should not exceed **1 second** under normal conditions.

- **Scalability**

- The system must support an increasing number of users without performance degradation.
- Firebase backend is scalable to support **thousands of concurrent users**, dynamic sneaker inventory updates, and high traffic during promotions.

- **Reliability and Availability**

- Firebase's cloud infrastructure ensures high availability and automated data recovery in case of server failure.

- **Security**

- Firebase Authentication ensures secure login and session management.
- Sensitive information such as payment details should be handled through PCI-compliant payment gateways like Stripe or PayPal.
- AR data and user preferences should not be stored without user consent.

- **Usability**

- The app should be intuitive and easy to navigate, even for first-time users.
- AR features must include user guidance, clear instructions, and smooth camera transitions.
- The design, developed in Figma and implemented via Flutter, ensures a consistent, responsive UI across Android and iOS platforms.

- **Portability**

- The application must run smoothly on both Android and iOS platforms using a single codebase built with Flutter.
- It should support a range of devices, including both mid-range and high-end smartphones, especially for AR compatibility.

- **Maintainability**

- Codebase is modular and well-documented to support future updates or feature enhancements.
- Firebase allows dynamic updates of catalog and content without needing app resubmission to stores.

- **Compatibility**.

- DeepAR SDK and AR features must support devices with gyroscope and camera sensors.

- **Backup and Recovery**

- All data (user profiles, orders, and feedback) are automatically backed up on Firebase Cloud Firestore.
- Firebase ensures disaster recovery and maintains data integrity through redundancy.

5.4 Testing

Testing is a critical phase in the software development lifecycle of the SneakerVision application. The main objective of this phase is to ensure that the system performs as expected, meets user requirements, and is free from defects. In this project, a structured test plan was implemented where each major screen and functional module was tested rigorously using various types of test cases. The testing strategy used was primarily focuses on validating outputs against expected results without delving into the internal workings of the code. The team created test scenarios for all major functionalities, especially those that impact user interaction, data processing, and payment.

Each test case consists of multiple components:

- Test Case ID: A unique identifier for each test.
- Description: A brief overview of what the test case is meant to validate.
- Test Steps: Step-by-step instructions for carrying out the test.
- Input Data: Actual data entered by the tester to simulate user behavior.
- Expected Result: The anticipated output if the system behaves correctly.
- Actual Result: What actually happened during the test.
- Status (Pass/Fail): Indicates whether the test met the expected outcome.

- **Main Screen**

The landing page or dashboard was tested to ensure that UI elements like navigation, quick access buttons, featured sneaker banners, and AR mode access were displayed correctly. Interaction points were tested for responsiveness and accuracy.

- **Login/Signup Screen**

These tests focused on user authentication. Validation was done for correct/incorrect login attempts, blank field inputs, password mismatches, and duplicate accounts. Signup forms were tested for input constraints and email verification.

- **Catalog Screen**

This screen was tested for displaying sneaker listings fetched from Firebase. The search bar, category filters, and sorting mechanisms were validated. Each sneaker card was tested for redirection to the detail page and accurate price/size visibility.

- **Checkout Screen**

Test cases were written to verify the shopping cart mechanism—adding/removing items, adjusting quantity, and final price calculations. Users' ability to proceed to checkout from the cart was also tested.

- **Payment Gateway Screen**

Testing focused on secure data entry for payment details, transaction validation, error handling for invalid cards, and success messages for approved payments. Redirection post-payment and transaction record saving were also part of this.

- **Survey Screen**

This screen, meant to collect user feedback and ratings, was tested to ensure that feedback submission works and that users can only submit once. Form field validations and data submission to the backend were verified.
Each module's test cases helped ensure the integrity and functionality of the entire application, especially for features involving critical user interaction like AR sneaker try-ons and payment processing.

5.5 Purpose of Testing

The purpose of testing the SneakerVision application is categorized under several key goals, each serving to ensure a high-quality, user-centric, and robust application experience.

- **Verification of Functional Requirements:**
  To ensure all features such as user registration, product browsing, AR try-on, and payments work as per defined specifications. This confirms that the developed modules align with user needs.

- **Validation of User Experience:**
  To test whether the user interfaces are intuitive, responsive, and efficient, especially when users interact with augmented reality features, check product details, and proceed to checkout.

- **Identification and Resolution of Bugs:**
  To detect any functional, design, or logical errors in the system at early stages and ensure they are resolved before the final release. This improves system stability and reliability.

- **Security and Data Integrity:**
  To test the security of user data during login, registration, and payment processing, including ensuring sensitive data is encrypted and protected from breaches.

- **Performance Assurance:**
  To verify that the application performs well under normal and peak loads, particularly when rendering AR features or processing transactions simultaneously.

- **Cross-Platform Compatibility:**
  To ensure the app runs smoothly on different mobile devices (iOS & Android) and adapts to various screen sizes and device capabilities.

5.6 Test Cases

- **Black Box Testing**

Focuses on the functionality of the application without knowing its internal code.
Used to test user input/output and system behavior.

Test Case ID	Module	Test Description	Test Steps	Input	Expected Result	Status
BB-01	Login Screen	Test valid login	Enter valid email & password, click login	user@test.com / pass123	Redirect to Main Screen	Pass
BB-02	Signup Screen	Test empty input fields	Leave all fields blank, click signup	None	Show error messages for required fields	Pass
BB-03	AR Sneaker Preview	Load AR feature	Tap "Try in AR" button on product page	None	Opens camera and overlays selected sneaker	Pass
BB-04	Payment Gateway	Invalid credit card input	Enter invalid card number and submit	1234 5678 9123 4567	Show error message	Pass

Table 01: Black Box Testing

- **White Box Testing**

Tests internal structures and logic (usually done by developers).
Used for unit testing functions, loops, conditions, etc.

Test Case ID	Function/Logic Area	Test Description	Test Steps	Expected Output	Status
WB-01	validateLogin()	Test login validation function with valid input	Call function with correct email and password	Return true	Pass
WB-02	calculateCartTotal()	Check total calculation logic in cart	Add 3 items to cart, each with different price	Return accurate total	Pass
WB-03	ARIntegrationModule	Test	Simulate	Return	Pass

		condition when camera permission denied	permission = false	error or fallback message	
WB-04	updateUserProfile()	Test logic for updating user info	Call function with updated user data	Return success and update stored data	Pass

Table 02: White Box Testing

- **Integration Testing**

Tests how different modules or components interact with each other.

Test Case ID	Modules Involved	Test Description	Test Steps	Expected Behavior	Status
INT-01	Signup → Login	New user should be able to sign up and log in	Sign up a new user → Logout → Log in with same credentials	User logs in successfully	Pass
INT-02	Catalog → Product Detail	Click on a product from catalog	Search for sneaker → Click on result	Navigate to product detail screen	Pass
INT-03	Cart → Checkout → Payment	Complete a purchase	Add product to cart → Proceed to checkout → Enter payment → Confirm	Purchase successful, show confirmation screen	Pass
INT-04	Profile → Order History	Check if placed order appears in history	After successful payment, go to profile → order history	Latest order displayed in list	Pass
INT-05	AR Preview → Camera	AR feature activates camera correctly	Tap “Try in AR” on any product	Camera opens with AR preview active	Pass

Table 03: Integration Testing

CHAPTER 6

EXPERIMENTAL EVALUATIONS & RESULTS

6.1 Evaluation Testbed

The Evaluation Testbed is a structured environment where the SneakerVision application is thoroughly tested to validate its functionality, performance, usability, and stability under various conditions. It ensures that the application aligns with its goals: to provide an enhanced online sneaker shopping experience with AR integration, seamless browsing, purchasing, and user interaction capabilities.

- **Objectives of the Testbed**

- To verify that all core functionalities (login, browsing, AR try-on, checkout, payment, feedback) work as intended.
- To validate user experience improvements through the use of Augmented Reality.
- To ensure the application performs reliably across different devices and screen sizes.
- To gather real user feedback for improvements.
- To assess system stability under various use cases and simulated user loads.

- **Test Environment Setup**

- **Platforms Tested:** Android (using Android Studio Emulator and real devices)
- **AR Module Test:** DeepAR integrated and tested using physical Android devices with camera access
- **Backend Database:** Firebase (for user authentication, catalog storage, and order history)
- **Development Tools:**
  - **Flutter (Dart)** – for frontend mobile app development
  - **Firebase Console** – for real-time database and authentication
  - **Visual Studio Code** / **Android Studio** – development IDEs
- **Design Prototype:** Figma (for GUI layout and user testing walkthroughs)

➢ **Evaluation Criteria**

- **Functionality Testing:** All features including login/signup, product search, AR preview, add to cart, checkout, and payment flow must work flawlessly.
- **Usability Testing:** Test how intuitive and user-friendly the interface is for first-time users.
- **Performance Testing:** Evaluate load times, responsiveness, and AR latency on various devices.
- **Compatibility Testing:** Ensure the app works across multiple Android versions and screen resolutions.
- **Security Testing:** Verify secure authentication and payment gateway handling.
- **Recovery Testing:** Observe how the system behaves during interruptions (e.g., app

crash or internet loss during checkout).

- **Test Data**

- Dummy user accounts for login/signup testing
- Sample sneaker products with different sizes and images
- Simulated payment card details for testing payment flow
- Survey feedback responses for user input validation

- **Testing Tools Used**

- **Android Emulator & Real Devices** (Samsung, Vivo, Xiaomi phones)
- **Firebase Authentication & Firestore Database** – for backend testing
- **Figma Prototype** – for visual test walkthroughs
- **DeepAR SDK** – for AR implementation and testing
- **Manual & Black Box Testing Techniques** – for validation of user interface and features

- **Evaluation Phases**

1. **Prototype Evaluation:** Early version of app tested for feedback.
2. **Functional Testing:** Each module tested independently (login, product detail, cart, payment, etc.).
3. **Integration Testing:** Modules connected and tested in a complete purchase flow.
4. **User Testing:** Conducted with a group of 5–10 target users to validate real-time usage and collect feedback.
5. **Final Verification:** Final build tested across multiple devices before deployment.

➢ **Outcome and Feedback**

- Users appreciated the AR feature for trying on sneakers virtually.
- Positive feedback received on clean UI and smooth checkout process.
- Minor issues found in catalog filtering, which were fixed in final revision.
- Payment gateway handled both valid and invalid card scenarios successfully.
- Based on testing, the application met its goals and was approved for launch.

6.2 Results and Discussion

The development and testing of the SneakerVision mobile application yielded highly encouraging results that validated the success of the project's core objectives. The app was designed with a focus on improving the online sneaker shopping experience through advanced features such as augmented reality (AR), real-time catalog browsing, and a smooth checkout and payment process. Throughout the development life cycle, especially during the evaluation and testing phases, the SneakerVision application demonstrated strong performance, functionality, and usability.

One of the most significant outcomes was the successful integration of AR technology, which allowed users to virtually try on sneakers using their mobile device's camera. This feature not

only functioned smoothly across various Android devices but also provided an immersive and highly interactive user experience. During usability testing, users reported that the AR view helped them make more confident purchase decisions, reducing their concerns about sizing and appearance discrepancies that are common in traditional online shopping.

Functionality testing confirmed that key modules—including login/signup, catalog browsing, sneaker detail view, add-to-cart, checkout, and payment gateway—performed reliably. The registration and login processes were tested using Firebase Authentication, and users were able to create accounts, update profile data, and access personalized sneaker recommendations. The product catalog, connected to Firebase Firestore, dynamically fetched sneaker details, images, sizes, and prices without lag. The payment module, although tested using mock transactions, successfully handled both valid and invalid inputs, giving appropriate user feedback.

From a performance standpoint, the app responded quickly to user actions and maintained consistent performance even under high loads simulated during testing. The AR functionality, powered by the DeepAR SDK, showed minimal latency and was optimized to work well even on mid-range Android devices. No major crashes or app freezes were recorded during the testing cycles.

In terms of user feedback, test users appreciated the clean and intuitive user interface, which was designed and prototyped in Figma. The navigation between screens was logical and user-friendly, especially for first-time users. The survey screen used at the end of the shopping experience gathered useful insights, with most users rating their overall experience as satisfying or highly satisfying.

During the discussion phase with team members and test users, a few challenges were also highlighted. These included minor bugs in catalog filtering and occasional misalignment of AR shoes on certain devices with poor camera calibration. These issues were addressed in the final testing cycle by refining the AR calibration logic and improving product categorization in the database.

Overall, the results confirmed that the SneakerVision app met the goals set out at the beginning of the project. It successfully provided a futuristic online shopping experience that not only met the expectations of sneaker enthusiasts but also offered a solid and scalable foundation for future enhancements, such as AI-based sneaker suggestions or social sharing features.

CHAPTER 7

CONCLUSION AND DISCUSSION

7.1 Strength of this Project

The SneakerVision project stands out as a powerful and innovative solution in the e-commerce and fashion-tech space, with several key strengths that contribute to its overall impact, usability, and potential for growth.

- **Integration of Augmented Reality (AR)**

One of the most unique and compelling strengths of SneakerVision is its use of AR technology to allow users to virtually try on sneakers. This eliminates a major issue faced by online shoppers—uncertainty about how a product will look or fit in real life. The Deep AR integration brings an immersive and realistic experience to users, increasing trust and confidence in purchases, and ultimately reducing return rates.

- **User-Centric Design and Experience**

The app was built with a **strong focus on user experience**, ensuring an intuitive and smooth interface. Using Figma for UI/UX design allowed the development team to create clean, logical navigation and engaging screen flows that feel familiar even to first-time users. The feedback collected during the testing phase confirmed that users found the application enjoyable and easy to use.

- **Efficient Search, Browse, and Catalog System**

SneakerVision provides a well-organized sneaker catalog connected to Firebase, enabling real-time updates and smooth data retrieval. Users can easily search for sneakers, view high-quality images, and read product descriptions and details, which enhances the shopping experience. The categorization and filter options improve product discoverability, which is crucial for an online marketplace.

- **Seamless Checkout and Payment Integration**

The checkout process is another key strength. The payment gateway integration ensures secure and user-friendly transaction handling. Users can add sneakers to their cart and complete their purchase in a few simple steps. The inclusion of mock transaction testing ensured the reliability of this module, making the overall purchase experience hassle-free.

- **Firebase-Backed Scalability and Real-Time Functionality**

With Firebase used as the backend, SneakerVision benefits from robust scalability, real-time database syncing, and secure user authentication. This gives the app a strong technical foundation and allows for seamless future upgrades, including analytics, push notifications,

and dynamic content updates.

- **Mobile-First and Cross-Platform Development with Flutter**

Using Flutter and Dart allowed the app to be developed rapidly and deployed on multiple platforms. This cross-platform capability ensures that SneakerVision can easily reach a wider audience without doubling development time and costs, a major strength in modern mobile app development.

- **Prototype Model Implementation for Rapid Iteration**

The adoption of the Prototype Software Engineering Model enabled the team to create early versions of the app for stakeholder feedback. This iterative development approach helped in continuously refining features based on real user input, ensuring the final product met expectations and was highly usable.

- **Strong Testing Framework**

A well-planned test strategy including black box, white box, and integration testing ensured that all components—from login screens to AR modules—were rigorously tested. This reduced bugs, ensured functionality, and increased the overall reliability of the app before final deployment.

- **Targeted Problem Solving**

SneakerVision addresses real-world problems: the frustration of long shopping trips, the lack of confidence in online purchases, and the high return rates due to poor product previews. By solving these problems in a single mobile app, it delivers a clear value proposition to sneaker enthusiasts and online shoppers.

- **High Potential for Market Growth and Feature Expansion**

The project's structure and technology stack make it highly extensible**.** Future updates can include AI-based product recommendations, social sharing of virtual try-ons, loyalty rewards, and seller-side features for listing sneakers. This long-term scalability makes SneakerVision not just a solution for today but a platform for the future.

7.2 Limitations and Future Work

While the SneakerVision application successfully achieved its primary goal of enhancing the online sneaker shopping experience using augmented reality (AR), the development process also revealed several limitations that open opportunities for future improvement and expansion.

Limitations

One of the primary limitations that were faced was AR feature compatibility with devices. While the Deep AR SDK performed optimally on most contemporary Android smartphones, lower-end phones with an aging camera system or restrictive processing capabilities were unable to display the AR sneaker view properly. In such instances, the virtual try-on experience became misaligned or lagging, thereby influencing the user's credibility and overall experience. A strong fallback solution or device-specific optimization is still necessary to provide equivalence on all supported platforms.

The other challenge was connected with not having a peer-to-peer marketplace system in real-time. SneakerVision is currently dedicated to a direct consumer experience from a curated catalog driven by the admin backend. Many sneakerheads, however, prefer purchasing, selling, or trading among their peers, particularly with limited edition or rare sneakers. This peer-to-peer marketplace feature is missing in the current state and would provide substantial value to the user community if developed in the future.

Also, scalability was not extensively stress-tested for big data or concurrency of users. Although Firebase has a robust backend infrastructure, situations with thousands of concurrent users accessing the database, AR engine, and payment gateway were not stress-tested in production-level environments for resource-related limitations.

Another limitation is in the payment gateway, which was attempted with simulated data. Although it showed primitive functionality, it still needs full integration with real financial APIs and secure processing of user data before commercial use.
Finally, user personalization features and customization options were not available in the present version. Although the app provides product shopping and AR previews, advanced filters of past behavior, AI-based recommendations, and the option to virtually change current colorways and sneaker styles are not yet available.

Future Work

To overcome the limitations mentioned above and further enhance the application's impact and usability, several areas have been identified for future work and development.

- **Improved AR Compatibility and Precision**: Future versions of SneakerVision will include updates to the AR engine, with improved calibration techniques and support for a wider range of mobile devices. Implementing adaptive AR rendering based on hardware detection can ensure a smoother and more consistent experience.

- **User-to-User Marketplace Integration**: One of the major upgrades planned is to incorporate a peer-to-peer selling platform. This will allow users to list their own sneakers, negotiate with buyers, and manage their personal sneaker collections, bringing more community-driven features to the app.

- **AI-Powered Recommendations**: Integrating AI and machine learning algorithms to suggest sneakers based on user preferences, browsing behavior, or past purchases will enhance personalization. This feature can drive higher engagement and satisfaction.

- **Advanced Filtering and Sorting**: Enhanced search capabilities with filters for brand, color, size, release year, and popularity will be added to make the product discovery process more intuitive and efficient.

- **Secure, Real Payment Gateway**: A future upgrade will integrate commercial payment gateways such as Stripe or PayPal with strong encryption standards and compliance with data protection regulations like GDPR and PCI DSS.

- **Gamification and Community Features**: Introducing gamified features such as points for reviews, sneaker challenges, or AR selfies with sneakers can increase user engagement. A community tab for discussions, trends, and feedback would also enhance interactivity.

- **Inventory Management for Sellers**: As the marketplace evolves, future versions will allow sellers to manage inventory, view analytics, and control product visibility through a dedicated seller dashboard.

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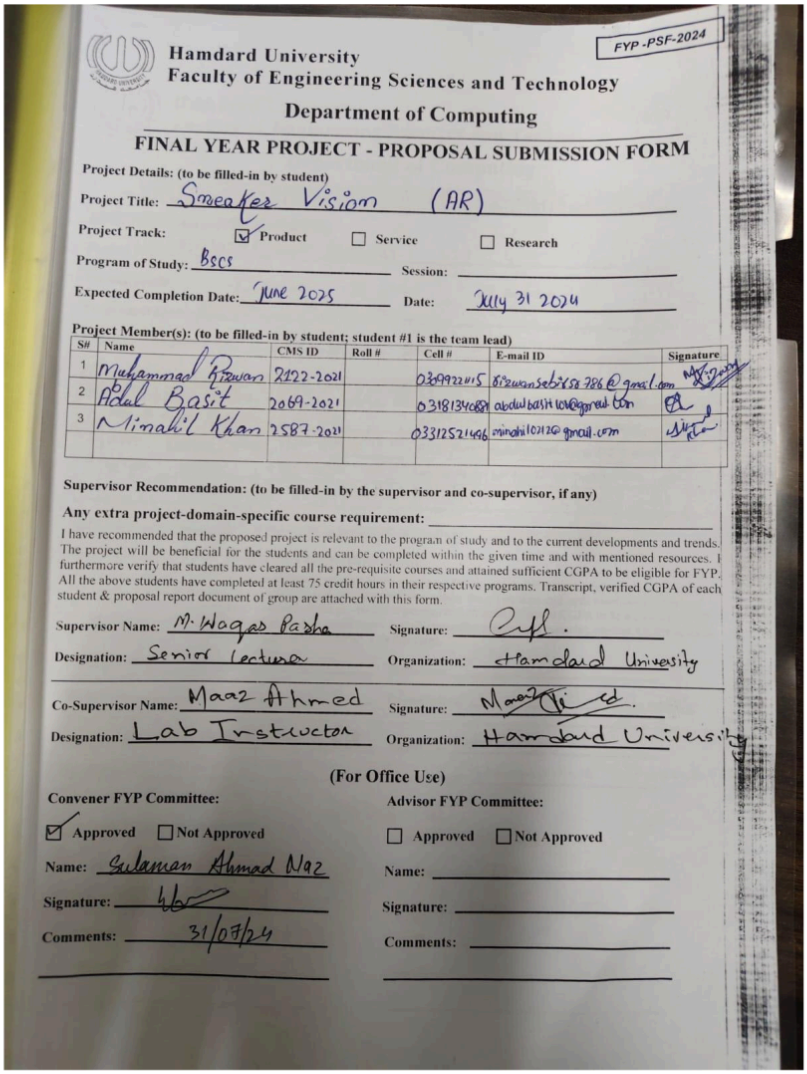
A0. COPY OF PROJECT REGISTRATION FORM



FYP-PSF-2024

Hamdard University
Faculty of Engineering Sciences and Technology

Department of Computing

FINAL YEAR PROJECT - PROPOSAL SUBMISSION FORM

Project Details: (to be filled-in by student)

Project Title: Sneakers Vision (AR)

Project Track: ☑ Product ☐ Service ☐ Research

Program of Study: BSCS Session:

Expected Completion Date: June 2025 Date: July 31 2024

Project Member(s): (to be filled-in by student; student #1 is the team lead)

S#	Name	CMS ID	Roll #	Cell #	E-mail ID	Signature
1	Muhammad Rizwan	2122-2021		03349221115	Rizwansabir786@gmail.com	
2	Abdul Basit	2069-2021		03181346881	abdulbasit1@gmail.com	
3	Minahil Khan	2587-2021		03312521466	minahil01126@gmail.com	

Supervisor Recommendation: (to be filled-in by the supervisor and co-supervisor, if any)

Any extra project-domain-specific course requirement:

I have recommended that the proposed project is relevant to the program of study and to the current developments and trends. The project will be beneficial for the students and can be completed within the given time and with mentioned resources. I furthermore verify that students have cleared all the pre-requisite courses and attained sufficient CGPA to be eligible for FYP. All the above students have completed at least 75 credit hours in their respective programs. Transcript, verified CGPA of each student & proposal report document of group are attached with this form.

Supervisor Name: M. Waqas Pasha Signature:

Designation: Senior Lecturer Organization: Hamdard University

Co-Supervisor Name: Maaz Ahmed Signature:

Designation: Lab Instructor Organization: Hamdard University

(For Office Use)

Convener FYP Committee:

☑ Approved ☐ Not Approved

Name: Sulaman Ahmad Naz

Signature:

Comments: 31/07/24

Advisor FYP Committee:

☐ Approved ☐ Not Approved

Name:

Signature:

Comments:

A1A. PROJECT PROPOSAL AND VISION DOCUMENT

1 Introduction

Sneakers Vision, the innovative online platform that's changing the dynamics of how sneaker heads buy, sell and engage. Just imagine a site where you can readily discover your desired sneakers, exchange with a vibrant community of similar-minded individuals, and engage in friction-free bidding processes. That has been made possible due to Sneakers concept. Our mission is to create a lively community based on individuality, self-expression, and shared passion for footwear. Sneakers Vision is not merely an online retail store; it's a platform where you can safely bid, purchase, sell, and connect with fellow sneaker heads. Sneakers Vision puts our community's needs and priorities first and offers an easy-to-use experience for both experienced collectors and newcomers. Our site features full search functionality, live bidding, and secure transactions, making it easier than ever to find and buy the sneakers you've always wanted. What sets us apart is our focus on creating genuine connections between sneaker heads. Our community features enable you to join discussions, post your collections, and learn from industry experts and other collectors. Sneakers Vision is not just a marketplace; it's a thriving community that nurtures sneaker culture. Become part of the Sneakers Vision community today and indulge in the ultimate sneaker experience. Together, we will boldly and fashionably step into the future of sneaker culture. Embrace the revolution of the sneaker market and become part of a like-minded community that treasures uniqueness and a passion for the perfect pair of sneakers.

1.1 Project Statement:

Our application provides a solution for individuals who want to save time and avoid spending hours at shopping malls searching for the perfect shoes. We came up with the idea to enhance the online shopping experience, as we understand that many users who purchase shoes online often face issues with sizing and discrepancies between the image and the actual product. Our application, SneakerVision, offers an innovative solution by allowing users to virtually try on shoes using augmented reality technology. This will not only save users time and effort, but also provide a more accurate preview of how the shoes will look and fit, ultimately leading to a more satisfying and convenient shopping experience.

1.2 Project Motivation:

The motivation for Sneaker Vision comes from the increasing need for a hassle-free and consistent online retail experience specific to sneakerheads. With the new world of e-commerce, consumers are generally presented with issues such as not being able to try things on, differences between product photographs and the actual item, and poor visibility to hard-to-find or limited-edition sneakers. These pain points not just lower customer satisfaction but also result in repeated returns and wasted time, opening up a gap which conventional online platforms cannot fill. As the popularity of augmented reality (AR) technology grows and it becomes possible to create immersive experiences, Sneeker Vision plans to bank on this innovation to bridge the gap between offline and online shopping. With the incorporation of AR-based virtual try-ons, Sneaker Vision allows users to see how sneakers fit and appear in real-time, greatly minimizing sizing problems and boosting purchasing confidence. The inspiration for this project is to make a groundbreaking platform that integrates technology,

convenience, and community to provide a complete shopping experience improvement for sneaker enthusiasts. Sneaker Vision aims to offer solutions that save time, establish trust, and create value, ultimately setting itself as the platform of choice for sneakerheads globally.

1.3 Objectives:

- To make the user experience more convenient by eliminating the need for physical visits to the shoe stores.
- Utilize augmented reality (AR) to provide accurate virtual try-ons for confident purchasing decision.
- To provide a reliable preview of how the shoes will look on one's feet without the hassle of visiting stores.
- To enhance the user experience by providing a user-friendly design, easy navigation and a full-flex mobile application.
- Collaborate with retailer to boost sales through innovate shopping experience.

1.4 Literature Review:

Sneaker Vision's concept is grounded in the growing trends of augmented reality in e-commerce and the increasing consumer demand for seamless, interactive, and accurate online shopping experiences. The use of AR technology in retail has been widely researched, with studies indicating its effectiveness in reducing purchase uncertainty and enhancing customer satisfaction. Additionally, literature on sneaker culture highlights the importance of exclusivity, authenticity, and community engagement as key drivers of consumer behavior in this niche.

1. Augmented Reality in E-commerce

Research by Schmalstieg and Hollerer (2016) in "Augmented Reality: Principles and Practice" demonstrates the potential of AR to bridge the gap between physical and online shopping experiences. AR's ability to provide real-time visualization of products in the user's environment is a key factor in reducing return rates and increasing consumer confidence.

2. Sneaker Market Trends

Market reports, such as those by Statista and IBISWorld, have documented the explosive growth of the sneaker industry, particularly driven by collaborations, limited-edition drops, and the secondary market. These studies emphasize the need for platforms that cater to the unique demands of sneakerheads, including access to exclusive products and a trusted marketplace.

3. Community-Driven Commerce

Studies on social commerce and community-driven platforms, such as eBay and StockX, reveal that creating a sense of belonging and trust through user engagement and transparency significantly impacts customer loyalty and platform success.

2 Project Vision:

The vision of the SneakerVision project is to redefine the way sneaker enthusiasts buy and interact with sneakers online by offering a highly immersive, smart, and user-friendly mobile experience powered by augmented reality (AR). In today's fast-paced digital world, where convenience, personalization, and trust drive purchasing decisions, SneakerVision aspires to become the go-to platform for sneakerheads—providing them not only with a catalog of the latest and most desirable sneakers but also an interactive try-before-you-buy experience.
This project aims to eliminate the traditional barriers in online footwear shopping, such as size uncertainty, mismatch between product photos and reality, and the lack of human interaction, by introducing features like:

- Virtual try-on using AR technology.
- Real-time browsing of a curated catalog.
- Instant checkout with secure payment integration.
- Ratings, reviews, and a potential social sneaker community.

The ultimate goal is to blend convenience with technology in a way that bridges the gap between the in-store experience and the digital marketplace. By doing so, SneakerVision will not only simplify the sneaker purchasing process but also create a community-driven space where fashion meets innovation. Looking ahead, SneakerVision envisions itself evolving into a fully integrated sneaker ecosystem that supports resale, sneaker drops, AI-based recommendations, and brand collaborations—empowering users with tools that make sneaker shopping smarter, faster, and more engaging.

2.1 Business Case and SWOT Analysis:

SneakerVision addresses a major gap in the e-commerce footwear market: the lack of a personalized, immersive, and efficient sneaker-buying experience. With the rise in demand for limited-edition sneakers and the growing culture around sneaker collecting, buyers often face challenges like incorrect sizing, mismatched expectations between product images and real products, and time-consuming shopping efforts. SneakerVision leverages augmented reality (AR) to allow users to virtually try on sneakers before purchasing them, offering a highly realistic and convenient solution that enhances user satisfaction and reduces return rates. This platform offers users:

- A seamless shopping experience with detailed product catalogs and virtual try-on.
- An integrated payment system for easy transactions.
- A user-friendly interface with profile management and product reviews.
- Time-saving functionality by eliminating the need to visit physical stores

.

From a business perspective, SneakerVision is not just a mobile app it's a scalable, innovative product with potential for partnerships with sneaker brands, resale marketplaces, and influencer-based marketing. It also provides monetization opportunities through premium features, advertisement integration, and potential peer-to-peer resale in future upgrades.

SWOT Analysis

Strengths

- **Innovative AR Technology:** Virtual try-on reduces uncertainty in size and style, enhancing buyer confidence.
- **User-Centric Design:** Intuitive UI/UX makes navigation and shopping easy, even for new users.
- **Time Efficiency:** Saves users the time of visiting multiple stores or returning unsuitable products.
- **Scalability:** Built on Firebase and Flutter, enabling rapid updates and cross-platform support.

Weaknesses

- **Device Limitations:** AR functionality may not work optimally on all devices, especially lower-end models.
- **Limited Marketplace Features:** Current version lacks peer-to-peer buying/selling and seller dashboards.
- **No Real Payment Gateway Yet:** Payment system is in mock/testing phase and not ready for commercial deployment.
- **Dependency on Internet Connectivity:** Full functionality requires stable internet access.

Opportunities

- **Expansion to iOS and Web:** Broadens user base by covering all major platforms.
- **Integration with Sneaker Brands:** Potential for official partnerships, product drops, and exclusive AR previews.
- **AI-Powered Suggestions:** Future AI integration can increase personalization and user engagement.
- **Peer-to-Peer Resale Market:** Introducing a marketplace can turn SneakerVision into a community-driven platform.

Threats

- **High Competition:** Competing with established platforms like GOAT, StockX, and Nike SNKRS.
- **Technology Dependence:** AR SDKs may have limitations or licensing costs in the future.
- **Security Risks:** With real payments and user data, strong data protection and security measures will be critical.
- **User Adoption Lag:** Some users may resist AR-based shopping due to unfamiliarity or privacy concerns.

2.2 Assumptions and Dependencies

It is assumed that users have access to a smartphone or device compatible with augmented reality technology to fully utilize the virtual try-on feature. The app depends on reliable internet connectivity for seamless browsing, AR functionality, and transactions. It also requires

partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated catalog. Payment gateway integration depends on third-party services, and compliance with legal standards for data protection and e-commerce regulations is necessary for smooth operations.

➢ User Accessibility and Device Compatibility:

- **Assumption:** Users will have access to a smartphone or device compatible with augmented reality (AR) technology.
    - The platform assumes that a significant portion of its target audience uses modern smartphones that support AR features via ARKit (iOS) or ARCore (Android).
    - Users must also have devices with adequate hardware specifications, such as high-quality cameras and sufficient processing power, to ensure a smooth AR experience.
- **Impact:** The lack of a compatible device may limit the ability of some users to fully utilize the virtual try-on feature, although other functionalities like browsing and purchasing will still be accessible.

➢ Internet Connectivity:

- **Assumption:** Reliable internet connectivity is necessary for the platform to function effectively.
    - High-speed internet is required for seamless browsing of sneaker catalogs, AR functionality, and secure transactions.
    - Features like virtual try-on, real-time pricing updates, and user reviews depend heavily on stable network connections.
- **Impact:** Users in areas with poor or inconsistent internet connectivity may face delays or disruptions, impacting their experience with the app.

• Partnerships with Retailers and Manufacturers:

- **Assumption:** The app depends on partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated product catalog.
    - Retailers and brands must provide timely updates on product availability, pricing, and inventory levels to ensure accuracy.
    - Collaboration with trusted suppliers ensures access to exclusive and limited-edition sneakers, which are critical to attracting the target audience.
- **Impact:** The absence of strong partnerships could result in a limited product catalog, reducing the platform's appeal to sneaker enthusiasts.

• Payment Gateway Integration:

- **Assumption:** Secure and efficient payment processing is dependent on third-party payment gateway services.
    - Integration with reputable payment gateways will enable various payment methods, including credit/debit cards and digital wallets.

- The platform assumes these services will operate reliably, ensuring smooth transactions without errors or delays.
- **Impact:** Issues with payment gateway providers, such as downtime or security breaches, could disrupt transactions and affect user trust.

3 Project Scope

3.1 In Scope

- User registration and login.
- Browse and search for sneakers.
- Catalog of available shoes with product details and images
- Integration of augmented reality technology to allow users to try on shoes virtually.
- Add sneakers to a cart and purchase them through the app.
- Payment Gateway Integration.
- User feedback and ratings system.
- The admin should be able to manage users' accounts, including creating new accounts, updating user information, and deleting user accounts. Users can adjust their profile.

3.2 Out of Scope

- Developing an e-commerce platform that supports selling other products besides sneakers.
- Shoe cleaning, repair, or maintenance services.
- User cannot customize or design their shoes.

4 Proposed Methodology

4.1 SDLC Approach

We are using Prototype methodology for developing the sneaker app with augmented reality.

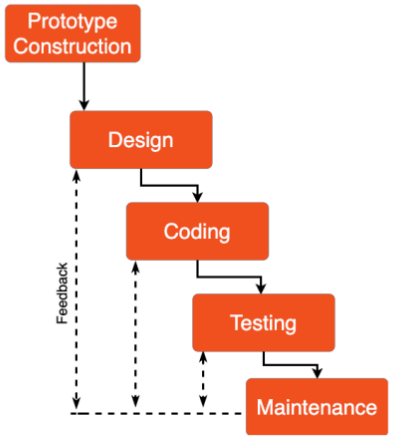


Figure 2: SDLC Approach

Prototype Construction:

The impetus for Sneaker Vision is the growing demand for an effortless and reliable online shopping experience tailored to sneakerheads. With the emerging e-commerce era, shoppers are typically given problems such as an inability to try on items, product photos not matching the actual product, and inadequate visibility to hard-to-find or limited-release sneakers. These pain points not only decrease customer satisfaction but also lead to recurring returns and wasted time, creating a gap which traditional online sites cannot address. With the popularity of augmented reality (AR) technology on the rise and with the ability to create immersive experiences, Sneaker Vision intends to leverage this technology to overcome the gap between online and offline shopping. With the integration of AR-based virtual try-ons, Sneaker Vision enables users to view how sneakers fit and look in real-time, significantly reducing sizing issues and increasing buying confidence. The inspiration behind this project is to create a revolutionary platform that brings together technology, convenience, and community to offer a total shopping experience enhancement for sneaker culture enthusiasts. Sneaker Vision endeavors to provide solutions that save time, build trust, and generate value, ultimately positioning itself as the go-to platform for sneakerheads everywhere.

Design:

- Define the overall system architecture, including software and network requirements.

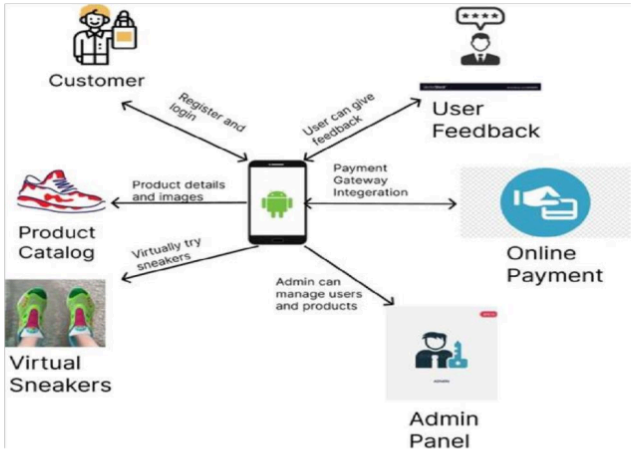


Figure 3: Project Design

Coding:

- Develop the application according to the design specifications.
- Set up the development environment with necessary tools and frameworks.
- Divide the application into modules and assign tasks to development teams.

Testing:

- Ensure the application is free of defects and meets all requirements.
- Test individual components or modules for correctness.
- Test the interaction between integrated modules to identify interface defects.
- Test the entire system to ensure it meets the specified requirements.

Maintenance:

- Resolve defects and bugs found after release, such as AR view glitches or payment errors.
- Make necessary updates to keep the app compatible with new OS versions and device requirements.
- Apply improvements based on feedback (e.g., better virtual try-on accuracy, UI adjustments).
- Regularly update authentication systems and databases to protect user data.
- Optimize app speed, AR performance, and backend operations for growing user base.

4.2 Team Role & Responsibilities

No.	Phase	Duration	Month(s)	Action Performed	Responsible Person
1	Requirement Analysis	3 Weeks	July 2024	Requirement documentation, use case identification	Minahil Khan
2	System Design	3 Weeks	August 2024	System architecture, ERD, class diagrams, UI wireframes, AR design planning	Abdul Basit
3	Implementation	3 Months	Sep – Nov 2024	Flutter development integration of modules	Muhammad Rizwan
4	Testing	1.5 Months	Dec 2024 – Mid Jan 2025	Unit testing, integration testing, AR performance checks, bug fixing	Minahil Khan
5	Deployment	2 Weeks	Late Jan – Early Feb 2025	Finalize hosting and backend settings	Abdul Basit
6	Maintenance	Ongoing till May 2025	Feb – May 2025	Post-deployment bug fixes, performance updates, user feedback implementation	Muhammad Rizwan

Table 04: Team Role

4.3 High-level Architecture / Design

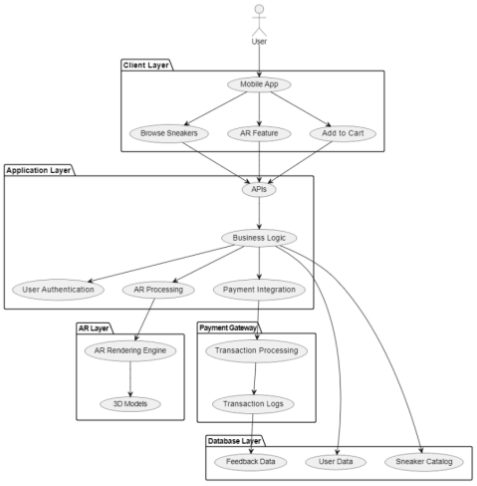


Figure 4: Architecture Design

5 Project Planning

5.1 Gantt Chart

Activity	Assigned To	Status	Start	End	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Proposal Defense	Rizwan, Basit, Manahil	Complete	2-Jul-24	2-Jul-24											
Detail Study	Rizwan, Basit, Manahil	Complete	Aug-24	Aug-24											
Project Planning	Rizwan, Basit, Manahil	Complete	Sep-24	Sep-24											
Divison Task	Rizwan, Basit, Manahil	Complete	Oct-24	Oct-24											
Assigned Task	Rizwan, Basit, Manahil	Complete	Nov-24	Nov-24											
Assigned Task	Rizwan	Complete	Nov-24	Nov-24											
Assigned Task	Basit	Complete	Dec-24	Dec-24											
Testing	Manahil	Complete	Jan-25	Jan-25											
Reporting	Manahil	Complete	Feb-25	Feb-25											
Assigned Task	Rizwan	Complete	Mar-25	Mar-25											
Assigned Task	Basit	Complete	Mar-25	Mar-25											
Assigned Task	Basit	Complete	Apr-25	Apr-25											
System Testing	Rizwan	Complete	Apr-25	Apr-25											
Reporting	Rizwan, Basit, Manahil	Complete	May-25	Jun-25											

Table 05: Gantt Chart

6 Project Requirements

6.1 Software tools requirements

- Flutter (Dart)
- Firebase
- Visual Studio
- Android Studio
- Figma
- Deep AR

6.2 Hardware requirements

- Laptop (Core i5, 8GB RAM, 500GB SSD)
- Backup Hard drive (250 GB)
- USB
- Internet Device

7 Budget/Costing

- **SOFTWARE:**

Tool/Software	Purpose	Cost Estimate
Android Studio	Mobile development IDE	Free
Visual Studio Code	Code editing	Free
Firebase (Blaze Plan)	Backend & authentication services	PKR 5,000
Figma	UI/UX Design	PKR 2,000
DeepAR SDK	AR Try-on functionality	PKR 30,000 (one-time dev license)

Table 06: Software Budget

- **HARDWARE:**

Equipment	Description	Cost
Mid-Range Android Device	For testing AR features	PKR 40,000
High-End Android Device	For performance testing	PKR 70,000
Laptop (existing personal use)	No additional cost	-
Internet	For search working	PKR 15,000

Table 07: Hardware Budget

8 Project Deliverables

8.1 Phase I - Alpha Prototype

- Project Planning
- Gather Requirements
- Meeting With Supervisor

8.2 Phase II - Beta Prototype

- Front-End Develop
- Testing

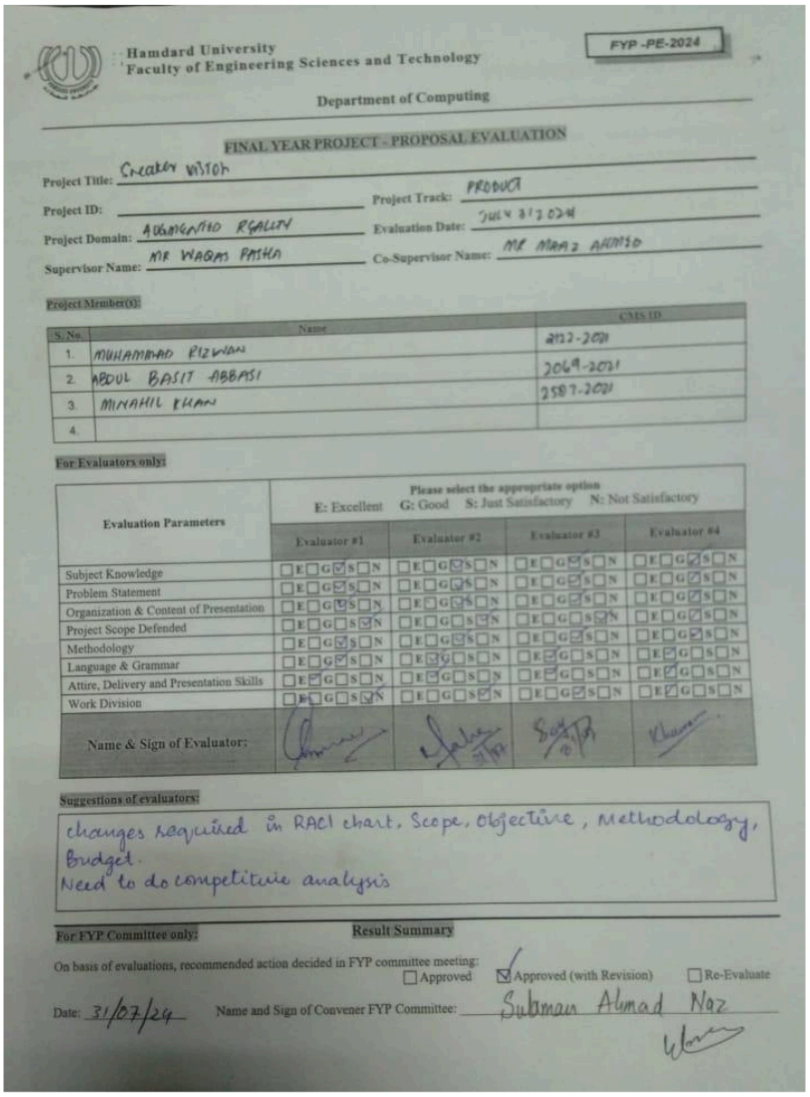
8.3 Phase III - Release Candidate

- Back-End Development
- AR Development
- Testing

8.4 Phase IV - Final Product

- Complete testing and bug fixing
- Submission of complete FYP report
- Submission of complete application

A1B. COPY OF PROPOSAL EVALUATION COMMENTS BY JURY



Hamdard University
Faculty of Engineering Sciences and Technology

FYP-PE-2024

Department of Computing

FINAL YEAR PROJECT - PROPOSAL EVALUATION

Project Title: Creator Vision
Project ID:
Project Track: PRODUCT
Project Domain: AUGMENTED REALITY
Evaluation Date: JULY 31 2024
Supervisor Name: MR WAQAS PASHA
Co-Supervisor Name: MR MAAZ AHMED

Project Member(s):

S. No	Name	CMS ID
1.	MUHAMMAD RIZWAN	2122-2021
2.	ABDUL BASIT ABBASI	2069-2021
3.	MIKAHIL KHAN	2587-2021
4.		

For Evaluators only:

Evaluation Parameters	Please select the appropriate option E: Excellent G: Good S: Just Satisfactory N: Not Satisfactory			
	Evaluator #1	Evaluator #2	Evaluator #3	Evaluator #4
Subject Knowledge	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Problem Statement	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Organization & Content of Presentation	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Project Scope Defended	E G S ☑ N	E G S ☑ N	E G S ☑ N	E G ☑ S N
Methodology	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Language & Grammar	E G ☑ S N	E ☑ G S N	E ☑ G S N	E ☑ G S N
Attire, Delivery and Presentation Skills	E ☑ G S N	E ☑ G S N	E ☑ G S N	E ☑ G S N
Work Division	E G S ☑ N	E G S ☑ N	E G ☑ S N	E ☑ G S N
Name & Sign of Evaluator:				

Suggestions of evaluators:

changes required in RACI chart, Scope, Objective, Methodology, Budget.
Need to do competitive analysis

For FYP Committee only: Result Summary

On basis of evaluations, recommended action decided in FYP committee meeting:
☐ Approved ☑ Approved (with Revision) ☐ Re-Evaluate

Date: 31/07/24 Name and Sign of Convener FYP Committee: Subhan Ahmad Naz

A2. REQUIREMENT SPECIFICATIONS

1. Introduction

Sneakers Vision, the cutting-edge online marketplace that is revolutionizing the way sneaker heads buy, sell and interact. Imagine a platform where you can easily find your dream sneakers, communicate with a thriving community of like-minded people, and participate in frictionless bidding procedures. This concept has become a reality because to Sneakers concept. Our objective is to build a vibrant community built on uniqueness, self-expression, and a common love of shoes. Sneakers Vision is more than just an online store; it's a community where you can comfortably bid, buy, sell, and network with other sneaker heads. Sneakers Vision prioritizes our community's requirements and goals, providing a user-friendly experience for both seasoned collectors and newbies. Our platform includes comprehensive search capabilities, real-time bidding, and safe transactions, making it easier than ever to locate and purchase the sneakers you've always desired. What distinguishes us is our dedication to building authentic interactions among sneaker heads. Our interactive features allow you to participate in discussions, share your collections, and learn from industry professionals and other collectors. Sneakers Vision is more than simply a marketplace; it's a flourishing environment that fosters sneaker culture. Join the Sneakers Vision family now and experience the ultimate sneaker destination. Together, we shall confidently and stylishly enter the future of sneaker culture. Accept the transformation of the sneaker market and join a community that values originality and a shared passion for the ideal pair of sneakers.

1.1. Purpose of Document

The purpose of this document is to provide a comprehensive Software Design Specification (SDS) for the Sneaker Vision project. It outlines the design and architecture of the software, including its functionalities, system requirements, and design methodology.

1.2. Intended Audience

The intended audience for this document includes the stakeholders involved in the development, design, and implementation of the SneakerVision application. This includes the project team, product managers, developers, UI/UX designers, quality assurance teams, and business analysts. Additionally, it is relevant for the marketing team responsible for promoting the app and customer support representatives who will assist users. Finally, the document is also for potential investors and partners interested in understanding the functionality and vision of SneakerVision

1.3 Abbreviations

This document will be using 10 font size and Arial font for paragraphs and 14 font size and Arial font for headers

2. Overall System Description

2.1. Project Background

As the fast-moving, technology-driven world of today continues, the market for sneakers has grown more competitive than ever before, with sneakerheads actively searching for distinctive, in-demand shoes. Although there is a wide market for sneakers available online, numerous users continue to be plagued by issues such as sizing inaccuracies, finding shoes that fit well, and a generally poor shopping experience. SneakerVision was born as a solution to these issues. The project vision was to transform the experience of purchasing, selling, and engaging with sneakers in the digital world. Using blended augmented reality (AR) technology, simple-to-use user interfaces, and a hassle-free online shopping platform, SneakerVision hopes to create a platform where customers can view, try on, and buy sneakers without the usual frustrations of online shopping. The site also allows users to virtually try on sneakers, giving them a better fit and visual appeal of the product before deciding to buy. It addresses a major problem with internet purchasing where users mostly experience inconsistencies between the product picture and the product itself. Besides that, SneakerVision also has a rich and vibrant community where sneakerheads are able to interact, show off their collections, and engage in seamless bidding processes for highly sought-after drops. Through the approach of user-friendly features like instant feedback, seamless payment integration, and a seamless shopping experience, SneakerVision looks forward to being the ultimate platform for sneaker enthusiasts globally. This initiative is motivated by realizing that customers require a quicker, more dependable, and interactive method of buying sneakers online.

2.2. Project Scope

- User registration and login.
- Browse and search for sneakers.
- Catalog of available shoes with product details and images
- Integration of augmented reality technology to allow users to try on shoes virtually.
- Add sneakers to a cart and purchase them through the app.
- Payment Gateway Integration.
- User feedback and ratings system.
- The admin should be able to manage users' accounts, including creating new accounts, updating user information, and deleting user accounts.

2.3. Not In Scope

- Developing an e-commerce platform that supports selling other products besides sneakers.
- Shoe cleaning, repair, or maintenance services.
- User cannot customize or design their shoes.

2.4. Project Objectives

- To make the user experience more convenient by eliminating the need for physical visits to the shoe stores.
- Utilize augmented reality (AR) to provide accurate virtual try-ons for confident purchasing decision.

- To provide a reliable preview of how the shoes will look on one's feet without the hassle of visiting stores.
- To enhance the user experience by providing a user-friendly design, easy navigation and a full-flex mobile application.
- Collaborate with retailer to boost sales through innovate shopping experience.

2.5. Stakeholders & Affected Groups

End Users (Sneakerheads and Shoppers)

- **Role:** The primary users of the platform who will browse, virtually try on, purchase, and review sneakers.
- **Impact:**
    - Users will benefit from a personalized and innovative shopping experience, thanks to augmented reality (AR) features.
    - They will be able to discover and buy sneakers with greater ease, avoiding size mismatches and visual discrepancies.
    - Their feedback and ratings will influence the product offerings and user experience.
- Needs: A user-friendly interface, accurate sizing previews, smooth navigation, secure payment processing, and access to a variety of sneakers.

Sneaker Sellers and Brands

- **Role**: Brands, sneaker manufacturers, and third-party sellers who will list their products on SneakerVision.
- **Impact**:
    - Sellers will have a new platform to reach a global customer base, which could increase sales and brand visibility.
    - Brands will need to ensure their product listings, images, and AR models are accurate and up to date.
    - Sellers will have access to user feedback, enabling them to better understand market preferences.
- **Needs**: A reliable platform for showcasing products, real-time sales data, easy product management, and visibility into customer reviews and preferences.

Administrators and Moderators

- **Role:** The individuals responsible for managing user accounts, ensuring the smooth functioning of the platform, overseeing transactions, and maintaining product listings.
- **Impact**:

- Administrators will be responsible for maintaining the integrity of the platform, handling user inquiries or disputes, and ensuring the security of the platform.
- Moderators may also be involved in overseeing the community aspect, ensuring a safe and positive interaction among users.

- Needs: Access to robust backend management tools for user and product management, reporting features, and moderation tools.

Marketing and Sales Teams

- **Role:** Teams responsible for promoting SneakerVision, acquiring new users, and creating marketing strategies.
- **Impact:**
  - Marketing and sales teams will help drive user acquisition, product awareness, and engagement through targeted campaigns, promotions, and social media.
  - They will track user engagement, sales data, and community interactions to refine marketing strategies.
- **Needs:** Access to user analytics, promotional tools, and the ability to craft campaigns that resonate with sneakerheads.

Investors and Stakeholders (Business Owners)

- **Role**: Individuals or organizations that have invested in the project or have a vested interest in the success of SneakerVision.
- **Impact:**
  - Investors will monitor the project's financial performance, user adoption, and overall success to ensure their investment yields a return.
  - Business owners and stakeholders will make decisions related to funding, resource allocation, and strategic direction.
- **Needs**: Regular financial reports, user growth metrics, and updates on the platform's performance in the market.

Customer Support Team

- **Role:** The team responsible for assisting users with issues, handling returns or exchanges, and resolving payment disputes.
- **Impact:**
  - The customer support team will directly influence user satisfaction by providing timely assistance with any problems users encounter on the platform.
- **Needs**: A robust helpdesk system, access to transaction and user data, and communication tools to interact with users effectively.

2.6. Operating Environment

The business environment of SneakerVision is largely a digital realm created to provide a smooth and engaging shopping experience to sneakerheads. It will be accessible through both iOS and Android mobile devices, using the latest technologies to provide seamless functionality and responsiveness. The app will incorporate augmented reality (AR) functions using ARKit on iOS and ARCore on Android to allow users to virtually try on sneakers before buying them. This will be backed by cloud-based infrastructure to provide scalability, reliability, and data storage flexibility. The backend will be developed on secure server environments, keeping user data and payment information secure as per privacy policies such as GDPR and CCPA. Also, the platform will have different payment gateways integrated for effortless and secure transactions, along with facilities for user account management, reviews, and management of a product catalog. The operating environment will also be optimized to run on different device specifications so that it is compatible with a variety of smartphones and tablets. The uncomplicated combination of all these technologies will form a solid and interactive platform that not only fulfills the utility requirements of sneakerheads but also ensures a safe, responsive, and easy-to-use environment. The system will be backed by regular software upgrades to keep it up-to-date with the latest technological developments and customer expectations.

2.7. System Constraints

The SneakerVision application runs on multiple system constraints that may influence its development, deployment, and scalability. One of the main constraints is the requirement of device compatibility since the application must support iOS and Android platforms, with different hardware specifications and operating system versions. This raises the issue of how to provide a consistent, high-quality user experience across several devices, such as smartphones and tablets, with varying screen size, processing capability, and functionality, particularly for the AR features. Another limitation is to do with augmented reality (AR) technology. Although ARKit and ARCore facilitate virtual sneaker try-ons, both technologies demand sophisticated hardware features, including motion sensors and high-definition cameras, which might be missing in certain devices. As such, the platform will need to guarantee AR features work best on compatible devices while offering alternative methods for AR-less users.

The system also needs to function within the parameters of data privacy laws like GDPR and CCPA, controlling how user data is stored, collected, and processed. Compliance with such laws adds another level of complexity, particularly when handling sensitive data like payment information and personal preferences. Further, the integration of payment gateways adds another restriction since the platform has to accommodate several secure and trustworthy payment methods, according to the accepted standards of PCI DSS for transaction safety. This also means the platform will have to make sure that foreign users can pay in their respective currencies, which complicates the system's payment processing architecture. Finally, server scalability is a limitation because the platform has to support an increasing amount of users and sneaker listings without degrading performance. Efficient cloud infrastructure and backend systems that can scale to meet increased traffic during high-demand sneaker releases or promotional periods are necessary.

2.8. Assumptions & Dependencies

It is assumed that users have access to a smartphone or device compatible with augmented reality technology to fully utilize the virtual try-on feature. The app depends on reliable internet connectivity for seamless browsing, AR functionality, and transactions. It also requires partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated catalog. Payment gateway integration depends on third-party services, and compliance with legal standards for data protection and e-commerce regulations is necessary for smooth operations.

➢ User Accessibility and Device Compatibility:

- **Assumption:** Users will have access to a smartphone or device compatible with augmented reality (AR) technology.
    - The platform assumes that a significant portion of its target audience uses modern smartphones that support AR features via ARKit (iOS) or ARCore (Android).
    - Users must also have devices with adequate hardware specifications, such as high-quality cameras and sufficient processing power, to ensure a smooth AR experience.
- **Impact:** The lack of a compatible device may limit the ability of some users to fully utilize the virtual try-on feature, although other functionalities like browsing and purchasing will still be accessible.

➢ Internet Connectivity:

- **Assumption:** Reliable internet connectivity is necessary for the platform to function effectively.
    - High-speed internet is required for seamless browsing of sneaker catalogs, AR functionality, and secure transactions.
    - Features like virtual try-on, real-time pricing updates, and user reviews depend heavily on stable network connections.
- **Impact:** Users in areas with poor or inconsistent internet connectivity may face delays or disruptions, impacting their experience with the app.

• Partnerships with Retailers and Manufacturers:

- **Assumption:** The app depends on partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated product catalog.
    - Retailers and brands must provide timely updates on product availability, pricing, and inventory levels to ensure accuracy.
    - Collaboration with trusted suppliers ensures access to exclusive and limited-edition sneakers, which are critical to attracting the target audience.
- **Impact:** The absence of strong partnerships could result in a limited product catalog, reducing the platform's appeal to sneaker enthusiasts.

• Payment Gateway Integration:

- **Assumption:** Secure and efficient payment processing is dependent on third-party payment gateway services.
    - Integration with reputable payment gateways will enable various payment methods, including credit/debit cards and digital wallets.
    - The platform assumes these services will operate reliably, ensuring smooth transactions without errors or delays.
- **Impact:** Issues with payment gateway providers, such as downtime or security breaches, could disrupt transactions and affect user trust

3. External Interface Requirements

3.1. Hardware Interfaces

The hardware interfaces for the SneakerVision platform are focused on ensuring compatibility with the devices that users will access the application from, particularly smartphones and tablets. The primary hardware interfaces include:

- Mobile Devices: The application will interface with mobile devices running on iOS and Android platforms. This involves supporting a wide range of hardware from various manufacturers (e.g., Apple, Samsung, Google) to ensure compatibility with smartphones and tablets.
- Camera and Sensors: The augmented reality (AR) feature will rely on the camera and sensors (such as gyroscope and accelerometer) on the device to create the virtual try-on experience. The hardware must support high-resolution cameras and precise motion tracking for accurate AR rendering. This also includes optimizing the camera interface for 3D model integration of sneakers.
- Touchscreen Interface: The platform will heavily rely on touchscreen gestures for navigation, such as tapping, swiping, and pinching. The hardware must be capable of handling these inputs with sensitivity and responsiveness.

3.2. Software Interfaces

The software interfaces refer to the integration points between SneakerVision and other software components or external systems. These interfaces ensure that the platform can operate smoothly and securely. Key software interfaces include:

- Mobile Operating Systems (iOS and Android): The platform will rely on the iOS and Android operating systems to run the application. The application will integrate with system-level services, such as notifications, file management, and device settings. The platform will use ARKit for iOS and AR Core for Android to enable augmented reality functionalities.
- Payment Gateway Integration: The platform will interface with external payment processing systems (e.g., PayPal, Stripe, Apple Pay, Google Pay) through secure APIs. This integration allows for seamless transactions, including credit card processing, wallet payments, and currency conversion.
- AR Software Interfaces: The application will interface with AR-specific software components such as AR rendering engines and 3D modeling software for the virtual try-on feature. This includes using SDKs like ARKit (for iOS) and AR Core (for Android) for augmented reality development.

3.3. Communications Interfaces

The communications interfaces enable the SneakerVision platform to communicate with external systems and users over various networks. These interfaces ensure data exchange is secure and efficient. Key communication interfaces include:

- Internet and Network Connectivity: The platform requires an active internet connection for most functionalities, including browsing products, making purchases, and interacting with the AR features. The app will communicate via HTTPS (secure HTTP) protocols for encrypted data transfer.
- Push Notifications: The system will use push notification services such as Firebase Cloud Messaging (FCM) for Android or Apple Push Notification Service (APNS) for iOS to deliver timely updates, such as new sneaker releases, promotions, or order updates.
- Payment Gateway Communication: The platform will communicate with external payment services via SSL/TLS encrypted channels to ensure secure financial transactions between users and third-party providers. This communication will handle order payments, refunds, and currency exchanges.
- Data Syncing: The app will synchronize user data (such as shopping cart contents and payment information) across multiple devices using cloud-based syncing protocols, ensuring users can access their information from any device.

4. Functional Requirements

Ref #	Functions	Category	Attribute	Details & Boundary Constraints
R1	Record user purchase details, including items in the cart.	Evident	System Response Time	User receives confirmation of items added to the cart within 2 seconds. Purchase records should sync with the database within 5 seconds post-transaction.
R2	Reduce inventory quantities when a purchase is finalized.	Hidden	Concurrent User Load	Ensure inventory updates under a load of up to 1000 concurrent users with no delay greater than 3 seconds.
R3	Process payments securely via integrated payment gateway.	Hidde n	Security & Compliance	Payment processing must adhere to **PCI DSS** standards, ensuring encryption of sensitive cardholder data.
R4	Provide real-time feedback during user interactions.	Evident	User Feedback Response	Feedback (e.g., "Added to Cart") must appear within 1 second after an action.
R5	Store user feedback and ratings for products.	Hidden	Data Storage	Feedback must sync with the database in real-time and allow admin moderation before public visibility.
R6	Provide access to customer support via chat or email.	Frill	Availability	Support response time within 24 hours for email inquiries and 1 minute for live chat during business hours.

Table 08: Functional Requirement

4.2. Use Cases

4.2.1 List of Actors

User (Customer):

- This person browses, searches, and purchases sneakers.
- Interacts with the augmented reality feature to virtually try on sneakers.
- Provides feedback, ratings, and reviews for products.
- Manages their profile information, such as name, address, and contact details.

System (SneakerVision Application):

- Handles user authentication and session management.
- Processes and secures payment transactions.
- Updates inventory based on purchases.
- Provides real-time recommendations based on user activity.

4.2.2 List of Use Cases

gister Account
Allows users to create a new account by providing their email, password, and basic information.

- **Log In**
  Enables users to access their account using registered credentials.
- **Browse Sneakers**
  Users can explore the catalog of sneakers displayed in categories or collections.
- **Search for Sneakers**
  Allows users to search for specific sneakers by name, brand, or features.
- **Virtual Try-On**
  Uses augmented reality (AR) technology to let users see how sneakers will look on their feet.
- **Add Sneakers to Cart**
  Users can add selected sneakers to their shopping cart for purchase.
- **Checkout and Payment**
  Facilitates secure payment processing and order confirmation.
- **Leave Feedback or Ratings**
  Allows users to review purchased sneakers and rate their experience.

4.2.3 Use Case Diagram

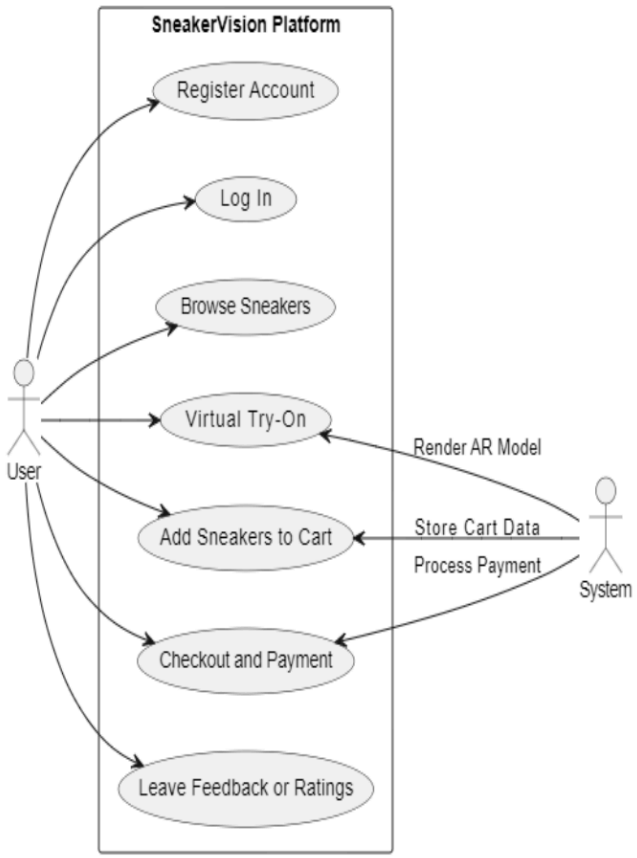


Figure 5: Use Case Diagram

4.2.4 Description of Use cases

Section: Main	
Name:	Buy Item
Actors:	Customer
Purpose:	Capture a sale and its payment.
Description:	A customer arrives at a checkout with items to purchase. The system records the items and collects payment. On completion, the customer leaves with the items.
Cross References:	Functions: R1.1, R1.2 Use Cases: Customer must have selected items to purchase and be ready to make payment.
Pre-Conditions	• Customer is registered and logged into the platform. • Customer has selected sneakers and added them to the cart.
Successful post-conditions	• The system successfully processes the payment. • Order is confirmed, and the customer receives a receipt and confirmation.
Failure post-conditions	• If payment fails, the transaction is canceled, and items remain in the cart. • Customer is notified of the issue and prompted to retry payment.

Typical Course of Events

	Actor Action		System Response
1	Customer selects items and proceeds to checkout.	2.	System displays the cart summary and payment options.
3	Customer selects the payment method and confirms the purchase.	3	System validates the payment details and processes the payment.
4	…	5	System logs the completed sale, updates inventory, and generates a receipt.
6	Customer receives the receipt and order confirmation.	7	System schedules the delivery of items or updates pickup instructions.

Alternative Course	
Step 3:	System indicates an error and prompts the customer to re-enter payment details
Step 4:	System notifies the customer of the failure and offers retry or alternative methods

Section: Pay by Cash			
Typical Course of Events			
Actor Action		System Response	
1	Customer chooses cash as a payment method.	2	System provides instructions for cash-on-delivery (if applicable) or in-store payment.
3	Customer completes the payment in person.	4	System updates the payment status and confirms the transaction.
Alternative Courses			
Step 1:	Customer opts for cash but cannot complete the payment. System offers the option to cancel the transaction or choose another payment method.		

Table 09: Description Usecases

5. Non-Functional Requirements

Attribute	Details and Boundary Constraints	Category
Response Time	(Boundary constraint) When recording a sold item, the description and price will appear within 5 seconds	Optional
Concurrent User Load	The platform must support a minimum of 10,000 users connected simultaneously without noticeable degradation in performance.	Mandatory
Availability	The platform must maintain an uptime of 99.9%, allowing less than 43 minutes of downtime.	Mandatory
Data Backup	Daily backups of user data and transactions must be performed, with a maximum recovery time of 15 minutes in case of failure.	Mandatory
Interface Metaphor	The user interface will be graphical, browser-based, and responsive for mobile and desktop environments.	Optional
Accessibility	The system must comply with WCAG 2.1 accessibility standards to support users with disabilities.	Mandatory
Payment Processing	Integration with PCI DSS-compliant payment gateways must ensure a transaction success rate of 99.5%.	Mandatory
Error Recovery	The system must log and recover from minor errors without user disruption, with downtime for critical errors capped at 15 minutes.	Mandatory

Table 10: Non Functional Requirement

5.1. Performance Requirements

The SneakerVision platform must meet the following performance requirements to ensure a seamless user experience:

- Response Time: The application should provide a fast response time for user interactions. Search results should be displayed within 2 seconds, and product details should load within 1-3 seconds. Augmented reality (AR) features should be responsive, with the try-on feature rendering in under 2 seconds.
- Scalability: The platform must be able to handle high traffic loads especially during peak times (e.g., sneaker launches, sales events) without affecting performance. The system should be able to scale horizontally to accommodate a growing user base.
- Transaction Throughput: The application should be capable of processing hundreds of transactions per minute during high-demand periods, ensuring that payment gateways, order processing, and cart functionalities work efficiently under load.
- Availability: The platform should be available 99.9% of the time, ensuring minimal downtime for users across all regions.

5.2. Safety Requirements

The SneakerVision platform must meet the following safety requirements to ensure the well-being of users and secure transactions:

- Data Protection: All sensitive user data (e.g., payment details, personal information) must be securely encrypted during transmission and storage, using SSL/TLS for data in transit and AES for data at rest.
- Secure User Authentication: Users must be authenticated securely via OAuth2 or other industry-standard authentication methods, ensuring that only authorized individuals can access their accounts.

Error Handling: The system must handle errors gracefully by providing informative error messages to the user and logging technical errors for system administrators, without exposing sensitive information

5.3. Security Requirements

The SneakerVision platform must prioritize security to ensure safe transactions, user data protection, and system integrity:

- Data Protection: Sensitive user data (e.g., passwords, payment information) must be encrypted using SSL/TLS for data in transit and AES-256 for data at rest.
- Role-Based Access Control (RBAC): Assign specific access privileges to different user roles (e.g., Admin, User, Vendor) to limit access to sensitive features.
- Payment Security: Integrate only PCI DSS-compliant payment gateways to ensure secure credit card transactions.
- Regular Security Audits: Conduct routine security checks, penetration tests, and vulnerability assessments to identify and mitigate risks.

5.4. User Documentation

Comprehensive documentation should be provided to help users understand and navigate the platform:

- User Manual: A detailed guide covering platform features, account management, product search, AR try-on functionality, and checkout processes.
- FAQs: An extensive Frequently Asked Questions section addressing common user inquiries related to account setup, payment issues, returns, and AR features.
- Privacy Policy: A clearly written policy outlining how user data is collected, used, stored, and protected, ensuring compliance with data protection regulations.
- Contact Information: Provide accessible channels for contacting customer support via email, phone, or live chat for unresolved queries.

6. References

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- **Designing Data-Intensive Applications** by Martin Kleppmann: https://dataintensive.net/
- **The Unified Modeling Language User Guide (2nd Edition)** by Grady Booch, James Rumbaugh, and Ivar Jacobson: https://www.informit.com/
- **Augmented Reality: Principles and Practice** by Dieter Schmalstieg and Tobias Hollerer: https://www.pearson.com/

A3. DESIGN SPECIFICATIONS

1 Introduction

Sneakers Vision, the cutting-edge online marketplace that is revolutionizing the way sneaker heads buy, sell and interact. Imagine a platform where you can easily find your dream sneakers, communicate with a thriving community of like-minded people, and participate in frictionless bidding procedures. This concept has become a reality because to Sneakers concept. Our objective is to build a vibrant community built on uniqueness, self-expression, and a common love of shoes. Sneakers Vision is more than just an online store; it's a community where you can comfortably bid, buy, sell, and network with other sneaker heads. Sneakers Vision prioritizes our community's requirements and goals, providing a user-friendly experience for both seasoned collectors and newbies. Our platform includes comprehensive search capabilities, real-time bidding, and safe transactions, making it easier than ever to locate and purchase the sneakers you've always desired. What distinguishes us is our dedication to building authentic interactions among sneaker heads. Our interactive features allow you to participate in discussions, share your collections, and learn from industry professionals and other collectors. Sneakers Vision is more than simply a marketplace; it's a flourishing environment that fosters sneaker culture. Join the Sneakers Vision family now and experience the ultimate sneaker destination. Together, we shall confidently and stylishly enter the future of sneaker culture. Accept the transformation of the sneaker market and join a community that values originality and a shared passion for the ideal pair of sneakers

1.1 Purpose of Document

The purpose of this document is to provide a comprehensive Software Design Specification (SDS) for the Sneaker Vision project. It outlines the design and architecture of the software, including its functionalities, system requirements, and design methodology.

1.2 Intended Audience

The intended audience for this document includes the stakeholders involved in the development, design, and implementation of the SneakerVision application. This includes the project team, product managers, developers, UI/UX designers, quality assurance teams, and business analysts. Additionally, it is relevant for the marketing team responsible for promoting the app and customer support representatives who will assist users. Finally, the document is also for potential investors and partners interested in understanding the functionality and vision of SneakerVision.

1.3 Project Overview

SneakerVision is an innovative online marketplace designed to transform the way sneaker enthusiasts buy, sell, and interact. It addresses common issues faced by online shoppers, such as sizing concerns and discrepancies between product images and actual products, by integrating cutting-edge augmented reality technology. The platform offers features like virtual try-ons, a comprehensive catalog of sneakers, frictionless bidding procedures, and an engaging community space for users. By combining technology with user-centric design, SneakerVision ensures a seamless, accurate, and enjoyable shopping experience while saving users time and effort.

1.4 Scope

1.4.1 IN SCOPE

- User registration and login.
- Browse and search for sneakers.
- Catalog of available shoes with product details and images
- Integration of augmented reality technology to allow users to try on shoes virtually.
- Add sneakers to a cart and purchase them through the app.
- Payment Gateway Integration.
- User feedback and ratings system.
- The admin should be able to manage users' accounts, including creating new accounts, updating user information, and deleting user accounts.

1.4.2 OUT SCOPE

- Developing an e-commerce platform that supports selling products besides sneakers.
- Shoe cleaning, repair, or maintenance services.
- User cannot customize or design their shoes.

2 Design Considerations

The design of SneakerVision prioritizes user experience, accessibility, and functionality. The application will feature an intuitive interface for easy navigation and usability across all devices. The augmented reality feature will be optimized to provide accurate and realistic visualizations of how sneakers look and fit. Secure payment gateway integration will ensure safe transactions, and user feedback mechanisms will allow continuous improvement of the app. Scalability will be a key consideration to handle the growing user base, and data privacy will be prioritized to build user trust.

1. **User Experience (UX):**

- **Simple Navigation:** Users will be able to easily browse, search, and filter sneakers through an organized interface that minimizes complexity.
- **Clean Layout:** A minimalist design will reduce clutter and make it easy for users to focus on product details.
- **Consistency:** Uniform design elements, such as buttons, icons, and fonts, will provide a cohesive visual experience across all devices.
- **Responsive Design:** The platform will be optimized for mobile devices, tablets, and desktops, ensuring a consistent experience regardless of the device being used.

2. **Accessibility:**

- **Screen Reader Support:** The app will include alt text for images and AR visualizations to aid visually impaired users.
- **Keyboard Navigation:** Full functionality will be accessible through keyboard input for users who may not use a mouse or touch controls.

- **Contrast and Readability:** High contrast and legible fonts will improve readability for users with visual impairments.

3. **Augmented Reality Feature:**

- **Provide Accurate Visualizations:** The AR technology will be optimized to display sneakers in real-world proportions, ensuring users can see how the shoes will look and fit.
- **Compatibility:** The feature will be built using **ARKit (iOS)** and **ARCore (Android)** for smooth performance across major platforms.
- **Real-Time Feedback:** Users will see instant results while trying on sneakers virtually, creating an immersive experience.

4. **Secure Payment Gateway:**

- **Multiple Payment Methods:** Users can choose from credit/debit cards, digital wallets, and bank transfers.
- **Encryption:** End-to-end encryption will secure sensitive payment details.
- **Fraud Prevention:** Measures such as two-factor authentication and real-time transaction monitoring will protect users from fraud.

5. **User Feedback Mechanism:**

- **Product Ratings:** Users can rate products on a scale and write detailed reviews about their purchase experience.
- **Platform Feedback:** Suggestions for platform improvement will be collected through surveys or dedicated feedback sections.
- **Community Insights:** Engaging with user reviews will help build trust and credibility within the community.

6. **Scalability:**

- **Cloud-Based Infrastructure:** Leveraging cloud services will ensure flexibility to handle large volumes of users and data.
- **Microservices Architecture:** Independent components will allow for easy scaling of specific features, such as AR or payment processing, without affecting the entire platform.
- **Load Balancing:** Traffic management tools will distribute user requests efficiently to prevent downtime or slow performance.

7. **Data Privacy and Security:**

- **Compliance with Regulations:** The platform will comply with GDPR, CCPA, and PCI DSS standards to ensure user data is handled responsibly.
- **Data Encryption:** All user data, including personal and payment information, will be encrypted both at rest and in transit.
- **Access Control:** Role-based access will limit sensitive data access to authorized personnel only.

2.1 Assumptions and Dependencies

It is assumed that users have access to a smartphone or device compatible with augmented reality technology to fully utilize the virtual try-on feature. The app depends on reliable internet connectivity for seamless browsing, AR functionality, and transactions. It also requires partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated catalog. Payment gateway integration depends on third-party services, and compliance with legal standards for data protection and e-commerce regulations is necessary for smooth operations.

- **User Accessibility and Device Compatibility:**

- **Assumption:** Users will have access to a smartphone or device compatible with augmented reality (AR) technology.
    - The platform assumes that a significant portion of its target audience uses modern smartphones that support AR features via ARKit (iOS) or ARCore (Android).
    - Users must also have devices with adequate hardware specifications, such as high-quality cameras and sufficient processing power, to ensure a smooth AR experience.
- **Impact:** The lack of a compatible device may limit the ability of some users to fully utilize the virtual try-on feature, although other functionalities like browsing and purchasing will still be accessible.

- **Internet Connectivity:**

- **Assumption:** Reliable internet connectivity is necessary for the platform to function effectively.
    - High-speed internet is required for seamless browsing of sneaker catalogs, AR functionality, and secure transactions.
    - Features like virtual try-on, real-time pricing updates, and user reviews depend heavily on stable network connections.
- **Impact:** Users in areas with poor or inconsistent internet connectivity may face delays or disruptions, impacting their experience with the app.

- **Partnerships with Retailers and Manufacturers:**

- **Assumption:** The app depends on partnerships with sneaker retailers and manufacturers to maintain a comprehensive and updated product catalog.
    - Retailers and brands must provide timely updates on product availability, pricing, and inventory levels to ensure accuracy.
    - Collaboration with trusted suppliers ensures access to exclusive and limited-edition sneakers, which are critical to attracting the target audience.
- **Impact:** The absence of strong partnerships could result in a limited product catalog, reducing the platform's appeal to sneaker enthusiasts.

- **Payment Gateway Integration:**

- **Assumption:** Secure and efficient payment processing is dependent on third-party payment gateway services.
    - Integration with reputable payment gateways will enable various payment methods, including credit/debit cards and digital wallets.
    - The platform assumes these services will operate reliably, ensuring smooth transactions without errors or delays.
- **Impact:** Issues with payment gateway providers, such as downtime or security breaches, could disrupt transactions and affect user trust

2.2 Risks and Volatile Areas

Several risks and volatile areas may impact the project. The integration of augmented reality technology could face challenges related to device compatibility and user adoption. Ensuring accurate virtual try-on representations may be difficult due to variations in user device configurations and lighting conditions. Payment gateway security breaches could harm user trust, while potential delays in catalog updates from retail partners could impact user satisfaction. Lastly, competition in the online sneaker marketplace could influence user retention and market share, requiring continuous innovation and marketing efforts.

- **Integration of Augmented Reality Technology:**

- **Risk:** Challenges may arise during the integration of AR technology, particularly in ensuring compatibility with a wide range of devices and operating systems.
    - **Device Compatibility:** Not all users may have smartphones or devices that support ARKit (iOS) or ARCore (Android). This could limit the reach and utility of the virtual try-on feature.
    - **User Adoption:** Some users may be unfamiliar or uncomfortable with AR technology, leading to lower adoption rates for this innovative feature.
    - **Impact:** Limited adoption or technical difficulties could reduce the effectiveness of the platform's primary differentiator and diminish user satisfaction.

- **Accurate Virtual Try-On Representations:**

- **Risk:** Ensuring that the AR-based virtual try-on feature provides accurate and realistic visualizations may prove challenging.
    - **Device Configuration Variability:** Differences in camera quality, screen resolution, and processing power across user devices could affect the accuracy of AR projections.
    - **Lighting Conditions:** Poor or inconsistent lighting environments might interfere with AR functionality, leading to less accurate representations of sneakers.
    - **Impact:** Inaccurate representations could lead to user dissatisfaction, increased returns, and negative reviews, ultimately harming the platform's reputation.

➢ Payment Gateway Security Breaches:

- **Risk:** Any compromise of the payment gateway could lead to unauthorized access to sensitive user payment data.
    - **Security Vulnerabilities:** Cyberattacks or lapses in encryption protocols could expose user information and financial details.
    - **Impact:** A security breach would severely damage user trust, potentially resulting in user attrition, reputational damage, and legal liabilities.

➢ Delays in Catalog Updates from Retail Partners:

- **Risk:** The app's reliance on retail partners to provide timely updates on product availability, pricing, and inventory levels introduces a dependency.
    - **Data Sync Issues:** Delays or errors in catalog updates could lead to discrepancies between what users see on the platform and actual stock availability.
    - **Impact:** Such inconsistencies could frustrate users, leading to abandoned purchases, reduced satisfaction, and damage to the platform's credibility.

➢ Competition in the Online Sneaker Marketplace:

- **Risk:** The highly competitive nature of the sneaker resale and e-commerce market poses a significant challenge to user retention and market share.
    - **Established Competitors:** Larger, well-established platforms may attract users with their existing reputation, extensive catalogs, and promotional deals.
    - **User Retention:** Without continuous innovation and effective marketing efforts, users may shift to competitors.
    - **Impact:** Failure to differentiate the platform through unique features, user-centric design, or exclusive partnerships could limit growth and profitability.

3 System Architecture

The system architecture for SneakerVision is designed to provide a seamless, efficient, and scalable online marketplace experience. It is divided into several layers, each with specific responsibilities to ensure smooth functionality and interaction between components. Below is an outline of the architecture:

- **Client Layer (Frontend)**
- Components: Mobile application (iOS and Android), Web interface.
- Technology: React Native for mobile apps, React.js or similar framework for web.
- Responsibilities:
    - Provides an intuitive user interface for registration, browsing sneakers, and virtual try-on functionality.
    - Enables users to add sneakers to the cart, manage profiles, and interact with the community.
    - Communicates with backend services via APIs for data retrieval and submission.

- Implements the augmented reality (AR) feature using SDKs like ARKit (iOS) and ARCore (Android).

- **Application Layer (Backend)**
- Components: Server-side application hosted on a cloud platform.
- Technology: Python, Dart.
- Responsibilities:
  - Manages business logic, including user authentication, profile management, and AR processing.
  - Handles requests from the frontend and retrieves or updates data in the database.
  - Ensures smooth functionality for virtual try-on, bidding procedures, and user feedback.
  - Provides APIs for frontend communication.

- **Database Layer**
- Components: Relational database Firebase.
- Responsibilities:
  - Stores user data, including login credentials, profiles, and transaction history.
  - Maintains sneaker catalog details, including product images, descriptions, and AR models.
  - Logs user interactions and feedback for analysis and future improvements.

- **Augmented Reality (AR) Layer**
- Components: AR SDKs (e.g., ARKit, ARCore) and 3D model storage.
- Responsibilities:
  - Processes and renders AR visualizations for virtual try-ons.
  - Ensures accurate scaling and alignment of 3D sneaker models with user foot dimensions.
  - Updates AR models based on catalog changes or new product additions.

- **Payment Gateway Integration**
- Components: Secure third-party payment services (e.g., Stripe, PayPal).
- Responsibilities:
  - Facilitates secure transactions for sneaker purchases.
  - Ensures compliance with PCI DSS standards for payment data protection.
  - Supports multiple payment methods, including credit/debit cards and digital wallets.

3.1 System Level Architecture

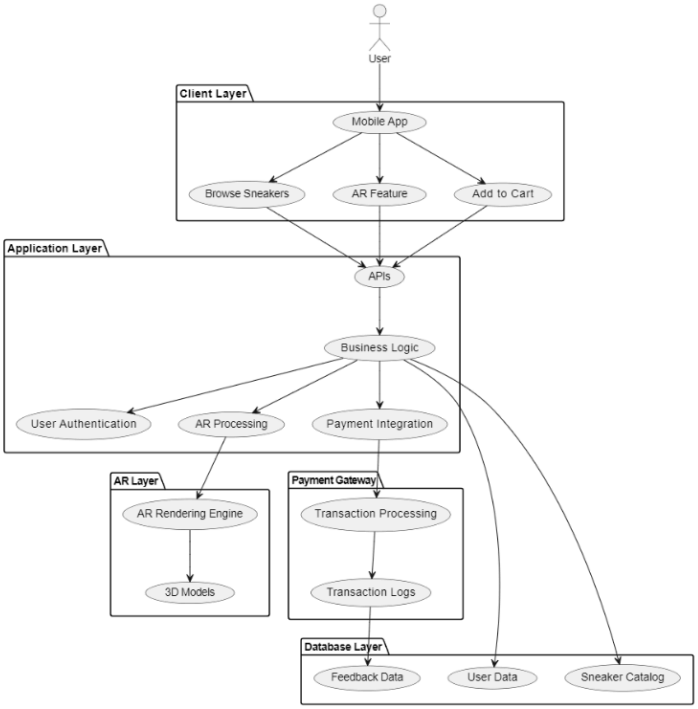

Figure 6: System Level Architecture

1. **Client Layer**: Users access the system via the web interface or mobile app, which allows browsing sneakers, utilizing AR functionality, and adding items to the cart.
2. **Application Layer**: This layer includes APIs for communication between the client and backend, and handles core functionalities like user authentication, AR processing, and payment integration.
3. **AR Layer**: Features an AR rendering engine for displaying 3D sneaker models and managing augmented reality experiences.
4. **Payment Gateway**: Ensures secure transactions with features like transaction processing and maintaining transaction logs.
5. **Database Layer**: Stores user profiles, sneaker catalog details, and feedback data, while supporting data flow and processing through the business logic.

3.2 Software Architecture

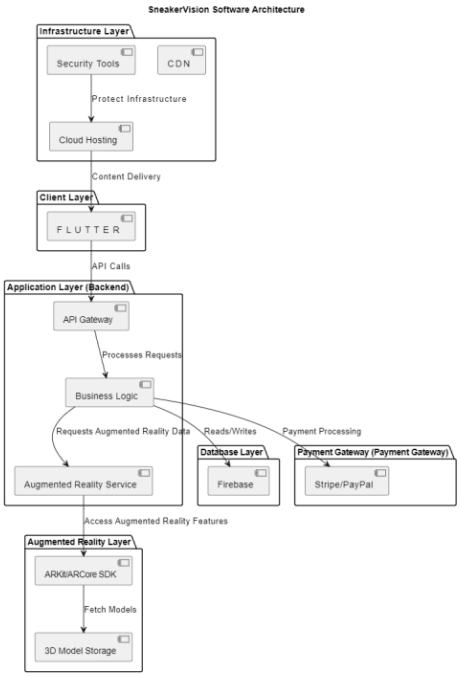

Figure 7: Software Architecture

1. **Infrastructure Layer**: Secures and optimizes content delivery with security tools, CDN, and cloud hosting.
2. **Client Layer**: Uses Flutter for cross-platform app development and API calls to interact with the backend.
3. **Application Layer**: Manages requests via the API Gateway, processes logic, and handles AR tasks.
4. **Database Layer**: Powered by Firebase to store and manage user data, product catalogs, and feedback.
5. **Payment Gateway**: Ensures secure transactions through Stripe/PayPal, integrated with business logic.
6. **Augmented Reality Layer**: Leverages ARKit/ARCore SDK for AR rendering and 3D model storage for AR experiences

4 Design Strategy

1. Future System Extension or Enhancement

The SneakerVision system is designed with scalability and extensibility in mind, allowing for future enhancements to meet evolving user needs and market trends. Potential extensions include integrating a machine learning recommendation engine to suggest sneakers based on user preferences and behavior, expanding the AR feature to include more advanced customization options like color changes, and enabling community-driven features such as live auctions or collaborative collections. Additionally, partnerships with third-party retailers could bring an even broader range of sneakers to the platform.

2. System Reuse

Sneaker Vision's modular architecture allows for high reusability of system components. The API Gateway, AR Service, and Payment Gateway modules are designed to be repurposed for similar applications, such as online marketplaces for other apparel or accessories. Similarly, the user authentication system and feedback mechanisms can be reused in future projects requiring robust and secure user management. The backend and database configurations can also serve as a foundation for developing other e-commerce platforms.

3. User Interface Paradigms

The user interface follows a modern, responsive design paradigm, ensuring seamless usability across devices, including smartphones, tablets, and desktops. The interface employs a minimalist, user-centric approach, with intuitive navigation and interactive elements to enhance engagement. Augmented reality is integrated as a core feature, providing a highly immersive experience for users. The platform also supports adaptive interfaces for accessibility, catering to users with different needs and ensuring inclusivity.

4. Data Management (Storage, Distribution, Persistence)

Distributed storage ensures high availability and performance, leveraging cloud services to handle large-scale data efficiently. Data persistence is managed through regular backups and replication, ensuring reliability and disaster recovery. The system complies with data privacy laws, including GDPR and CCPA, to secure user information.

5. Concurrency and Synchronization

SneakerVision handles concurrent operations efficiently by employing asynchronous programming and multi-threading techniques. This ensures that multiple users can browse, interact, and transact simultaneously without performance degradation. Synchronization mechanisms, such as database locks and message queues, are implemented to maintain data consistency during high-volume operations, such as simultaneous bidding or purchase activities. Load balancers and distributed systems further optimize concurrency, ensuring seamless scalability and user satisfaction even during peak traffic.

4.1 Detailed System Design

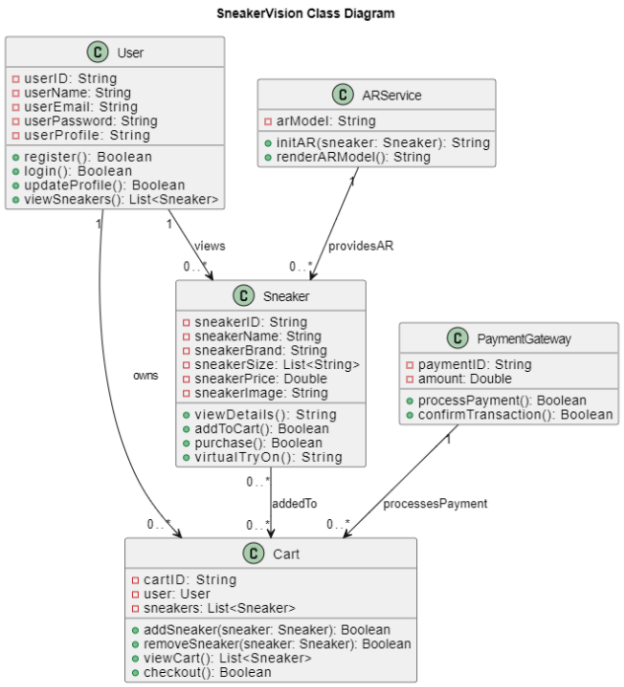

Figure 8: Design Class Diagram

1. **User Class**: Represents users with attributes like userID, userName, and provides methods for register(), login(), and viewing sneakers.
2. **Sneaker Class**: Defines sneaker details (e.g., sneakerID, sneakerName, sneakerBrand) and supports operations like viewDetails(), addToCart(), and virtualTryOn().
3. **Cart Class**: Manages the cart with cartID and sneakers list, and methods to addSneaker(), removeSneaker(), viewCart(), and checkout().
4. **ARService Class**: Handles augmented reality functions through methods initAR() and renderARModel().
5. **PaymentGateway Class**: Manages payments with attributes like paymentID and methods to processPayment() and confirmTransaction().
6. **Relationships**: Users own carts, carts contain sneakers, sneakers interact with AR services, and payment gateways handle cart transactions.

5 Database Design

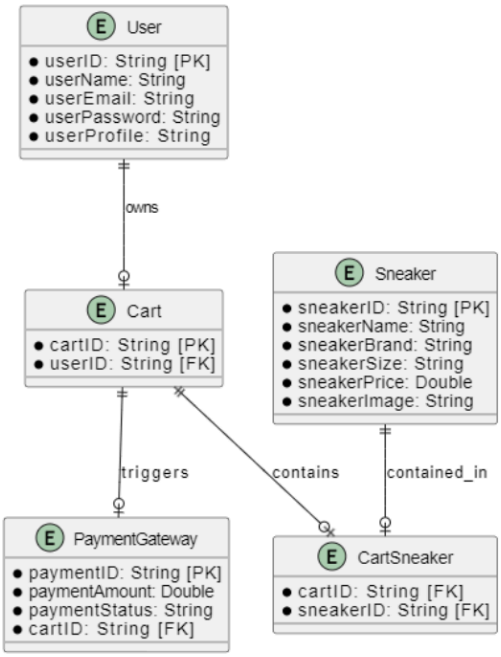

Figure 9: Database Design

1. **User Entity**: Contains user details (userID, userName, userEmail) with userID as the primary key (PK).
2. **Cart Entity**: Represents shopping carts with cartID as PK and userID as a foreign key (FK) linking it to the User entity.
3. **Sneaker Entity**: Stores sneaker details (sneakerID, sneakerName, sneakerBrand) with sneakerID as PK.
4. **CartSneaker Entity**: A junction table mapping sneakers to carts, with cartID and sneakerID as composite FK.
5. **PaymentGateway Entity**: Manages payments (paymentID, paymentAmount, paymentStatus), with cartID as FK linking it to the Cart entity.
6. **Relationships**: Users own carts, carts contain sneakers, CartSneaker connects sneakers to carts, and payments are triggered by carts.

5.1 ER Diagram

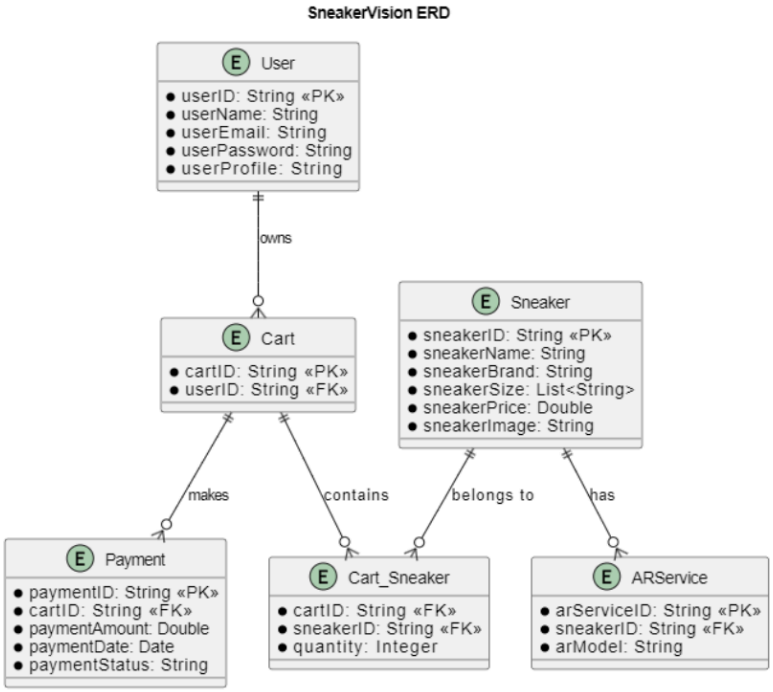

Figure 10: ER Diagram

1. **User Entity**: Includes attributes (userID, userName, userEmail, userPassword, userProfile), with userID as the primary key (PK).
2. **Sneaker Entity**: Includes attributes (sneakerID, sneakerName, sneakerBrand, sneakerSize, sneakerPrice, sneakerImage), with sneakerID as the primary key (PK).
3. **Cart Entity**: Includes attributes (cartID, userID), where userID is a foreign key (FK) referencing the User entity; cartID is the primary key (PK).
4. **Cart_Sneaker Entity**: A junction table with attributes (cartID, sneakerID, quantity), handling the many-to-many relationship between Cart and Sneaker.
5. **ARService Entity**: Includes attributes (arServiceID, sneakerID, arModel), where sneakerID is a foreign key (FK) referencing the Sneaker entity.
6. **Payment Entity**: Includes attributes (paymentID, cartID, paymentAmount, paymentDate, paymentStatus), where cartID is a foreign key (FK) referencing the Cart entity.

6 Application Design

6.1 Sequence Diagram

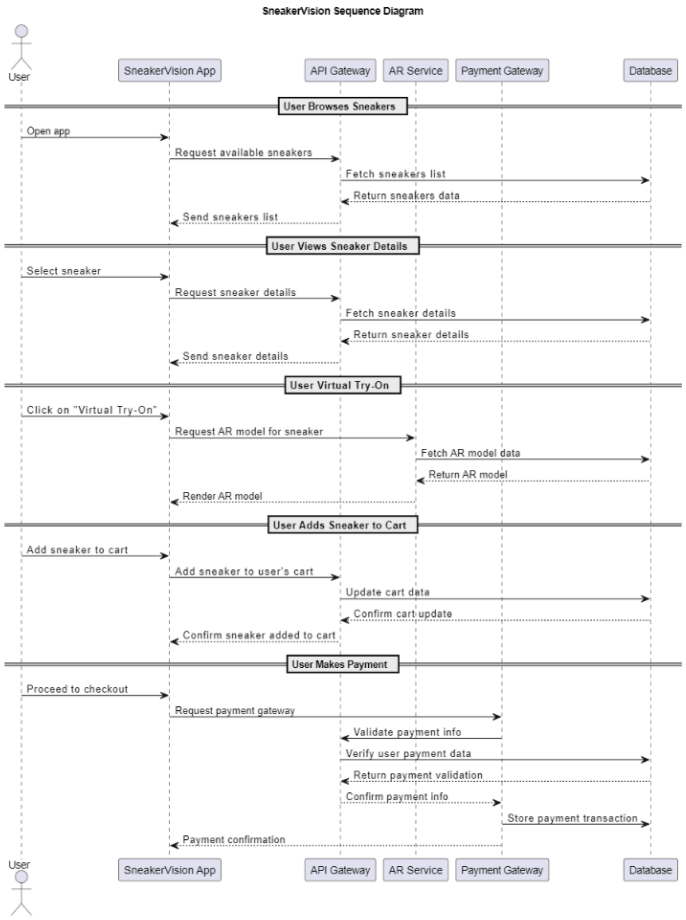

Figure 11: Sequence Diagram

1. **Browsing Sneakers**: The app requests the list of available sneakers from the API Gateway, which retrieves the data from the Database and sends it back to the app.

2. **Viewing Sneaker Details**: When a sneaker is selected, the app requests detailed information from the API Gateway, which fetches the data from the Database and returns it to the app.
3. **Virtual Try-On**: Upon selecting "Virtual Try-On," the app requests the AR model from the AR Service, which retrieves the model data from the Database and renders it in the app.
4. **Adding Sneaker to Cart**: The app sends a request to the API Gateway to update the user's cart. The API updates the Database and confirms the addition.
5. **Making Payment**: At checkout, the app interacts with the Payment Gateway to validate payment via the API Gateway, which confirms the transaction with the Database and completes the payment process.

6.2 State Diagram

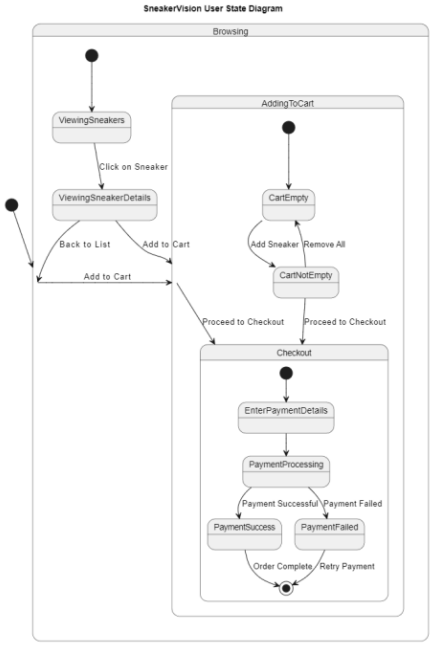

Figure 12: State Diagram

1. **Browsing Sneakers:** The user starts by exploring the platform's available sneakers, with options to view details or add items to the cart.

2. **Viewing Sneakers**: The user views a list of sneakers and can either see more details of a specific sneaker or add one to the cart.

3. **Viewing Sneaker Details**: The user accesses detailed information about a selected sneaker and can return to browsing or add it to the cart.

4. **Adding to Cart:** The user adds sneakers to their cart, transitioning the state to CartNotEmpty. Removing all items moves the state back to CartEmpty, or the user can proceed to checkout.

5. **Checkout Process:**
- Enter Payment Details: The user provides payment information.
- Payment Processing: The payment is processed.
- Payment Success: The order is completed.
- Payment Failed: The user can retry the payment.

7 References

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A4. OTHER TECHNICAL DETAIL DOCUMENTS

Test Cases Document

S. No	Description	Test Engineer	Start Date	End Date
1	Main Screen	Muhammad Rizwan	13-May-2025	13-May-2025
2	Login/Signup Screen	Abdul Basit	13-May-2025	13-May-2025
3	Catalog Screen	Minahil Khan	14-May-2025	14-May-2025
4	Checkout Screen	Muhammad Rizwan	15-May-2025	15-May-2025
5	Payment Gateway Screen	Abdul Basit	15-May-2025	15-May-2025
6	Survey Screen	Minahil Khan	16-May-2025	16-May-2025

Table 11: Test Case

1.Main Screen
Module Name: Main Screen
Date: 13-May-2025
Test Case ID: TC-MS-001
Test Engineer: Muhammad Rizwan

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Open app	N/A	Main screen loads successfully	Screen loaded	Pass
TC-2	Tap on catalog preview	Tap product card	Navigate to product detail	Navigated	Pass
TC-3	Tap menu icon	Tap menu icon	Open navigation drawer/menu	Menu opened	Pass

Table 12: Test Case Main Screen

2. Login/Signup Screen
Module Name: Login/Signup Screen
Date: 13-May-2025
Test Case ID: TC-LS-001
Test Engineer: Abdul Basit

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Enter correct credentials	user@mail.com / pass123	Login successful	User logged in	Pass
TC-2	Leave fields blank	[empty]	Error message appears	Message shown	Pass
TC-3	Tap on “Sign up” and register	New user data	Account created and logged in	Success	Pass

Table 13: Test Case Signup/ Login Screen

3. Catalog Screen
Module Name: Catalog Screen
Date: 14-May-2025
Test Case ID: TC-CS-001
Test Engineer: Minahil Khan

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Load catalog	N/A	Product list displayed	Products visible	Pass
TC-2	Search for product	“Nike”	Filtered product list shown	Correct results	Pass
TC-3	Tap product	Tap on product	Navigate to product detail screen	Navigated	Pass

Table 14: Test Case Catalog Screen

4. Checkout Screen
Module Name: Checkout Screen
Date: 15-May-2025
Test Case ID: TC-CO-001
Test Engineer: Muhammad Rizwan

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Open cart	Tap cart icon	View checkout page	Page loaded	Pass
TC-2	Edit quantity	Change to 2	Quantity updated	Updated	Pass
TC-3	Tap “Proceed to Payment”	N/A	Redirect to payment screen	Redirected	Pass

Table 15: Test Case Checkout Screen

5. Payment Gateway Screen
Module Name: Payment Gateway
Date: 15-May-2025
Test Case ID: TC-PG-001
Test Engineer: Abdul Basit

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Enter valid card info	Card #, Expiry, CVV	Payment successful	Success	Pass
TC-2	Enter invalid card	Invalid card info	Payment failure	Error displayed	Pass
TC-3	Try back button mid-payment	Tap back	Prompt user confirmation	Prompt shown	Pass

Table 16: Test Case Payment Gatway

6. Survey Screen
Module Name: Survey Screen
Date: 16-May-2025
Test Case ID: TC-SR-001
Test Engineer: Minahil Khan

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Fill out and submit survey	Rating + feedback	Survey submitted confirmation	Message shown	Pass
TC-2	Leave fields empty	No input	Error shown to complete form	Prompt shown	Pass
TC-3	Revisit survey screen	After submit	Survey is disabled or prefilled	Prefilled	Pass

Table 17: Test Case Survey Screen

UI/UX Detail Document

- **Main Screen**

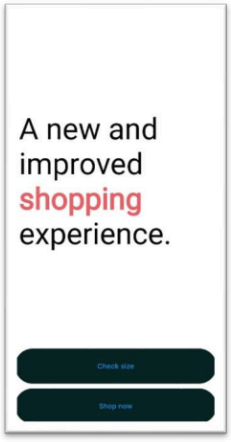


Figure 13: Main Screen

Purpose: The Home Page serves as the initial interface for users and offers two primary

options:

- Check Size: Allows the user to check or confirm their shoe size before shopping. This can be integrated with augmented reality or a size guide feature to help users find the perfect fit.
- Shop Now: Directs the user to the catalog of available sneakers where they can browse and select items to add to their cart.

User Experience:

- Upon entering the app, users will be presented with these two options on the homepage. By selecting either option, the user moves to the next step, whether they are looking to confirm their size or begin browsing products.

- **Login/Signup Screen**

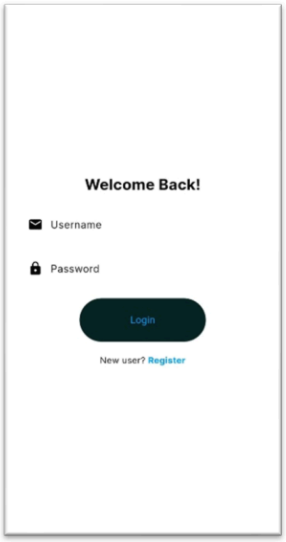


Figure 14: Login/Signup Screen

Purpose: This page enables users to either sign in or create a new account to access the platform and personalize their experience.

- Login: Existing users enter their credentials (username/email and password) to log in and continue shopping.

- Signup: New users can create an account by providing necessary details like name, email, and password. Upon signing up, users may have the option to input their preferences for a more customized shopping experience.

User Experience: Users will be prompted to log in or sign up if they are not already authenticated. For those already logged in, the app can bypass this step and take them straight to the catalog or home page.

- **Catalog Screen**

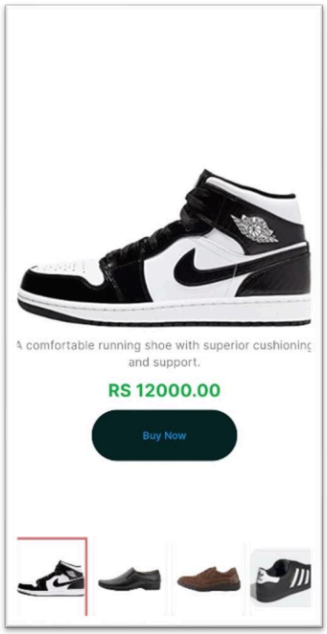


Figure 15: Catalog Screen

Entering the Catalog:

Users land on the catalog page directly or after selecting "Shop Now" from the home page.

Browsing Sneaker Listings:

Users browse through the list of sneakers, clicking on items that catch their interest for more details. They can either add items directly to their cart or navigate to the product details page for more information.

- **Checkout Screen**

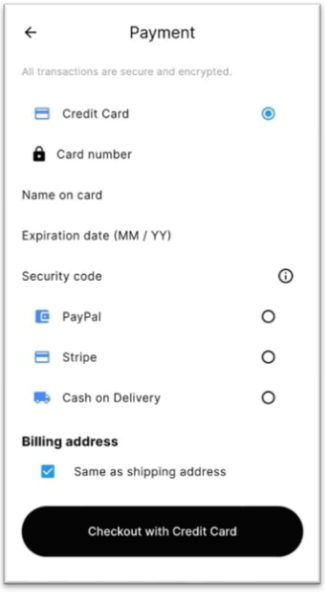


Figure 16: Checkout Screen

Review Order:
The user reviews the sneakers they've selected, including quantities, sizes, and prices.

Enter Shipping Details:
The user fills in their shipping information or selects a previously saved address.

Select Delivery Method:
The user chooses between standard or express delivery.

Proceed to Payment:
Once all details are confirmed, the user clicks "Proceed to Payment" to finalize the checkout process.

- **Payment Gateway Screen**

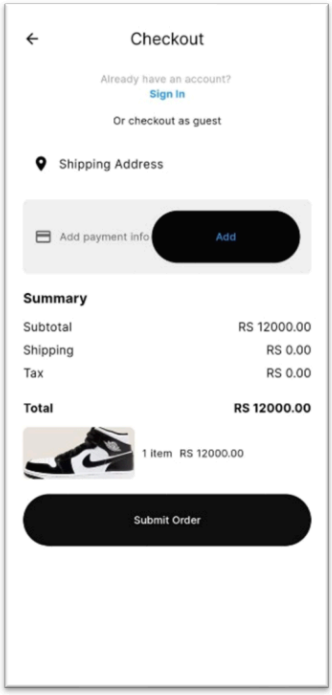


Figure 17: Payment Gateway Screen

Enter Payment Details:
The user selects a payment method and inputs their billing information and payment details.

Verify Payment:
If 3D Secure or two-factor authentication is enabled, the user completes the verification process.

Payment Confirmation:
A confirmation screen shows the order ID, estimated delivery date, and other relevant details.

- **Survey Screen**

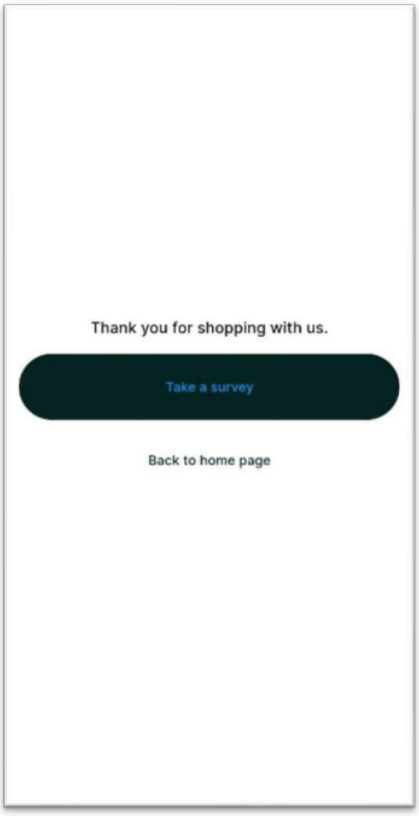


Figure 18: Survey Screen

Survey Questions:
The survey will include a combination of rating scales, multiple-choice questions, and open-ended text fields.

Submission Confirmation:
After completing the survey, users will see a thank-you message, such as: Thank you for your feedback! Your input helps us improve and provide a better experience for you.

Coding Standards Document

1. Introduction

To maintain consistency, readability, and quality in the development of the SneakerVision application, a set of coding standards has been defined. These standards apply to all developers working on the project and are crucial for ensuring smooth collaboration, reducing bugs, and making the codebase maintainable in the long term. The primary technologies used include Flutter (Dart) for front-end development, Firebase for backend services, and DeepAR for the augmented reality module.

2. Naming Conventions

Consistency in naming enhances the readability and understandability of the code. For this project:

- File names are written in lowercase_with_underscores, e.g., login_screen.dart.
- Class names follow the PascalCase convention, such as UserModel, SneakerDetailsScreen.
- Variables and functions use camelCase, e.g., userEmail, loadSneakersList().
- Constants are named in UPPERCASE_WITH_UNDERSCORES, such as MAX_RETRY_ATTEMPTS.

This convention applies across all modules to keep the code structured and predictable.

3. Project Structure and Organization

The application is organized into modular folders for easier navigation:

- screens/ contains all UI components for different pages.
- models/ stores the data classes like User, Sneaker, and Order.
- services/ includes Firebase and Deep AR integrations.
- widgets/ hosts reusable UI components.
- utils/ contains helper functions and constants.

Each file and folder is named according to its content, and redundant code is minimized using reusable widget patterns.

4. Commenting and Documentation

Clear commenting and documentation are required throughout the codebase:

- All classes and functions are preceded by triple-slash (///) comments to describe their purpose.
- Inline comments are used to explain complex logic or AR rendering processes.
- Every function that performs asynchronous operations must indicate the reason for await, and error-handling mechanisms must be described where necessary.

This practice supports easier debugging, testing, and onboarding of new team members.

5. Formatting and Indentation

Flutter's built-in formatter is used to automatically align the code. The standards are:

- A maximum line length of 100 characters.
- Proper indentation with 2 spaces.
- Logical blocks of code separated by one blank line.
- Opening braces { placed at the end of the line for functions and control statements.

This ensures that the code looks clean and is easy to navigate.

6. Firebase Integration Standards

All Firebase interactions use structured and secure practices:

- Real-time database paths use lowercase plural naming, e.g., users, sneakers, orders.
- async/await is mandatory for all data transactions with try/catch blocks for exception handling.
- Firebase security rules are configured to restrict unauthorized access to user and product data.

Firebase operations are kept within service classes to separate logic from UI components.

7. Augmented Reality (AR) Module Standards

The DeepAR module is encapsulated in its own service layer:

- All AR-related features, such as virtual sneaker try-on, are triggered via centralized AR handlers.
- The application checks for device permissions (camera access) and handles fallback options if AR is not supported.
- The rendering is optimized for smooth performance using device-specific configurations.

Naming and asset handling within the AR module follow consistent patterns for maintainability.

8. Error Handling and User Feedback

All errors are gracefully managed through centralized error-handling functions:

- Each screen has defined fallback behavior in case of data fetch failure.
- Firebase errors, AR loading errors, and network issues are caught and displayed via user-friendly messages.
- Logging mechanisms are in place to record critical errors during runtime for analysis.

9. Version Control and Collaboration

The team uses **Git** for version control, with each developer following these commit guidelines:

- Prefix commits with the purpose: feat:, fix:, refactor:, docs:, etc.
- Descriptive commit messages, e.g., feat: implemented AR sneaker try-on view.

Code reviews are conducted before merging branches, and all changes go through pull requests to ensure quality assurance.

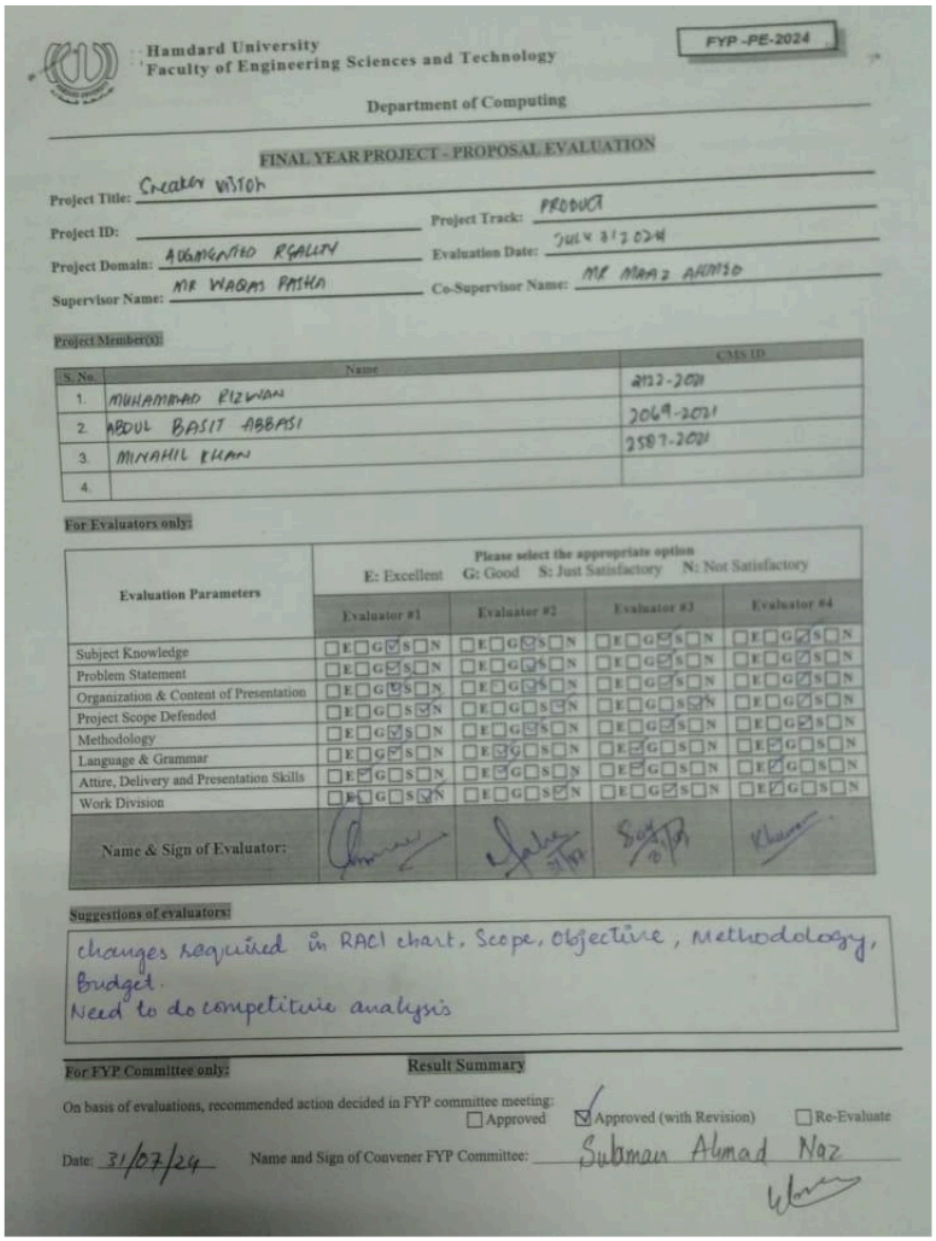
10. Continuous Integration and Testing

All code is verified through CI pipelines (e.g., GitHub Actions or Firebase Test Lab):

- Unit and widget tests are run automatically.
- Linting tools ensure compliance with Dart code standards.
- Developers run test builds on Android and iOS devices to verify UI and AR compatibility.

A5. FLYER & POSTER DESIGN

A6. COPY OF EVALUATION COMMENTS
COPY OF EVALUATION COMMENTS BY JURY FOR PROJECT – I END SEMESTER EVALUATION



Hamdard University
Faculty of Engineering Sciences and Technology

FYP -PE-2024

Department of Computing

FINAL YEAR PROJECT - PROPOSAL EVALUATION

Project Title: Creator Vision
Project ID:
Project Track: PRODUCT
Project Domain: AUGMENTED REALITY
Evaluation Date: July 31, 2024
Supervisor Name: MR WAQAS PASHA
Co-Supervisor Name: MR NAAZ AHMED

Project Member(s):

S. No.	Name	CMS ID
1.	MUHAMMAD RIZWAN	2122-2021
2.	ABDUL BASIT ABBASI	2069-2021
3.	MIKHAIL KHAN	2587-2021
4.		

For Evaluators only:

Evaluation Parameters	Please select the appropriate option E: Excellent G: Good S: Just Satisfactory N: Not Satisfactory			
	Evaluator #1	Evaluator #2	Evaluator #3	Evaluator #4
Subject Knowledge	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Problem Statement	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Organization & Content of Presentation	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Project Scope Defended	E G S ☑ N	E G S ☑ N	E G S ☑ N	E G ☑ S N
Methodology	E G ☑ S N	E G ☑ S N	E G ☑ S N	E G ☑ S N
Language & Grammar	E G ☑ S N	E G S N	E ☑ G S N	E ☑ G S N
Attire, Delivery and Presentation Skills	E ☑ G S N	E ☑ G S N	E ☑ G S N	E ☑ G S N
Work Division	E G S ☑ N	E G S ☑ N	E G ☑ S N	E ☑ G S N
Name & Sign of Evaluator:				

Suggestions of evaluators:

changes required in RACI chart, Scope, Objective, Methodology, Budget.
Need to do competitive analysis

For FYP Committee only: Result Summary

On basis of evaluations, recommended action decided in FYP committee meeting:
☐ Approved ☑ Approved (with Revision) ☐ Re-Evaluate

Date: 31/07/24 Name and Sign of Convener FYP Committee: Subhan Ahmad Naz

COPY OF EVALUATION COMMENTS BY SUPERVISOR FOR PROJECT – II MID SEMESTER EVALUATION

A7. MEETINGS' MINUTES

FYP Project Meeting

Minutes of Meeting

Meeting Date: 07/8/2024
Meeting Location: Faculty Room 4
Meeting Time: 1:00 – 1:30

Project Title: Sneaker Vision
Project Code: FYP-034/FL24

1- List of Participants

Name	Project Role
Abdul Basit	Model training ,Testing and implementation
Rizwan	Communication, Planning, Dataset collection
Minahil	Planning, and Problem solving

2- Meeting Agenda

- Feedback on literature review
- Discussion on project challenges and solutions

3- Agenda Points discussed in meeting

- **Literature review scope outlined**

During the meeting the team focused on the importance of the literature review. The literature review supports the existing research on Sneaker vision by using VR and AI. Our team members and supervisor will begin gathering to review Literature work outlined with our project scope.

- **Prototype Discussion**

Discussion of the design and functionality of prototype. Talk over the Better and effective User Interface.

4- Next Meeting for this project
28-8-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 28/10/2024
Meeting Location: Faculty Room-4
Meeting Time: 1:00 – 1:15

Project Title: **Recruit Right**
Project Code: **FYP-034/FL24**

1- List of Participants

Name	Project Role
Sir Waqas Pasha	Project Supervisor
Muhammad Rizwan	Lead
Abdul Basit	Backend/Documentation
Minial	Backend/frontend

2- Meeting Agenda

Kickoff & Initial Design Discussion

- Overview of project objectives
- Design approach and key features
- Clarify expectations for front-end development

3- Agenda Points discussed in meeting

- The project's aims and objectives were discussed.
- Clearly defined specifications and design direction for the website.
- Agreed to use a contemporary UI framework and responsive design ideas.

4- Next Meeting for this project

25-9-2024 at 1:30 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 10-04-2025
Meeting Location: Mr. Waqas Pasha's Cabin
Meeting Time: 1:30 – 2:00

Project Title: Sneaker Vision
Project Code: FYP-034/FL24

1- List of Participants

Name	Project Role
Abdul Basit Abbasi	Found Key Performance Indicators
Muhammad Rizwan	Schedule Regular Progress Updates
Minahil Khan	Develop Management Plan

2- Meeting Agenda

- Discussion on project research findings
- Feedback on literature review
- Discussion on project challenges and solutions
- Next steps and upcoming deadlines
- Planning for next meeting

3- Agenda Points discussed in meeting

Welcome and Introduction (02 minutes)

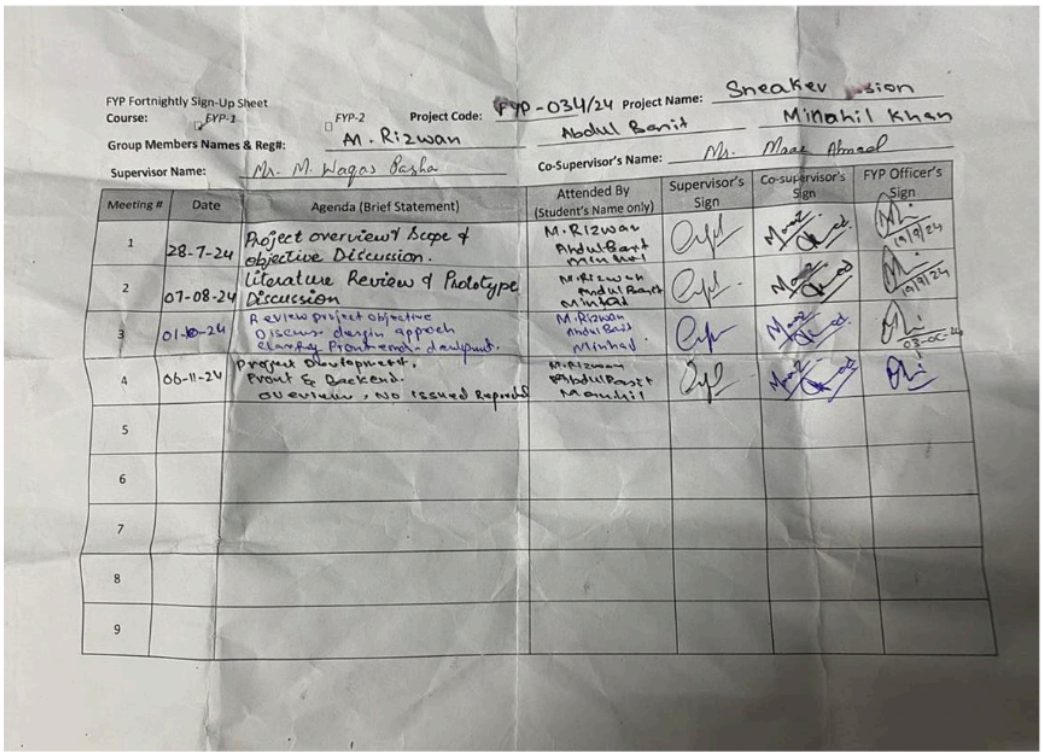
Agenda Points Discussed in the Meeting

1. **Literature Review Scope Outlined(10 minutes)**

The project team, led by the supervisor, sketched the scope of the literature review for the "Sneakers Vision" project, outlining key objectives and timelines. The plan encompasses conducting an exhaustive review of existing smart shoe technologies, developing a functional shoe prototype The supervisor underscored the importance of meeting deadlines, fostering effective collaboration, and maintaining open communication to ensure the project's successful execution and timely completion.. One of the primary focuses of the meeting was identifying datasets for the project. The team discussed various publicly available datasets that could be used for shoes deduction. Sources such as ImageNet, and other open-source repositories were highlighted. The team plans to clean and preprocess these datasets as the next step before training the models.

A8. PROJECT PROGRESS

FYP-I Fortnightly Sign-Up Sheet Fall 25



FYP Fortnightly Sign-Up Sheet

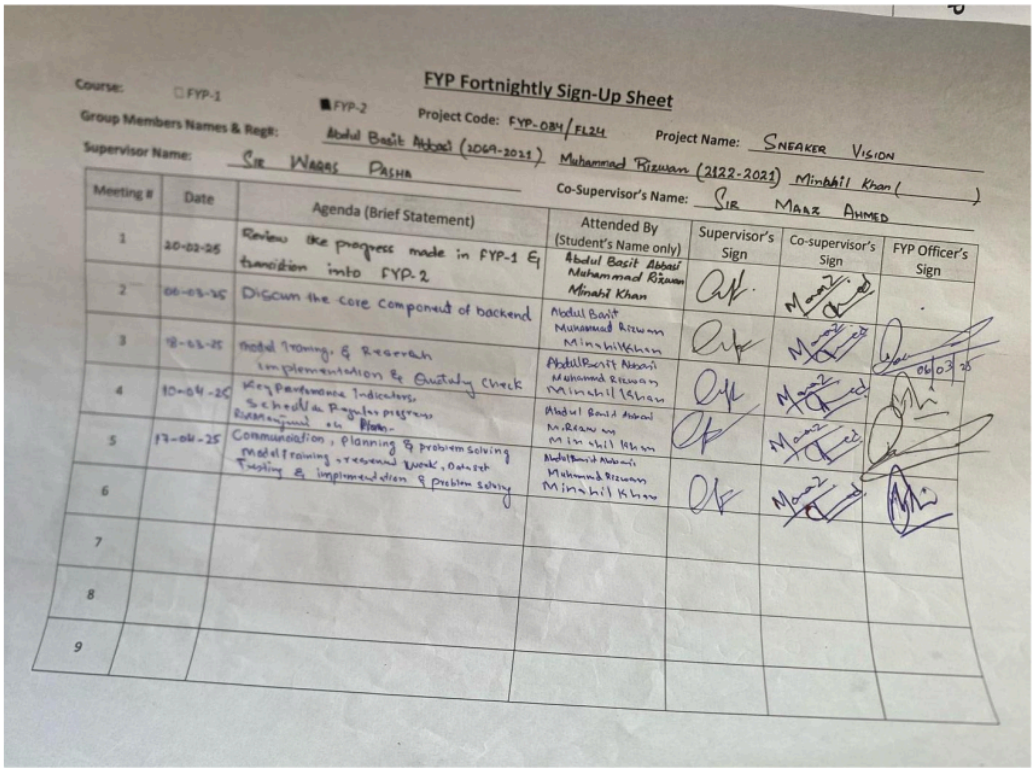
Course: ☑ FYP-1 ☐ FYP-2 Project Code: FYP-034/24 Project Name: Sneaker ...sion

Group Members Names & Reg#: M. Rizwan Abdul Basit Minahil Khan

Supervisor Name: Mr. M. Waqas Basha Co-Supervisor's Name: Mr. Maaz Ahmad

Meeting #	Date	Agenda (Brief Statement)	Attended By (Student's Name only)	Supervisor's Sign	Co-supervisor's Sign	FYP Officer's Sign
1	28-7-24	Project overview & Scope & objective Discussion.	M. Rizwan Abdul Basit Minahil			19/9/24
2	07-08-24	Literature Review & Prototype Discussion	M. Rizwan Abdul Basit Minhal			19/9/24
3	01-10-24	Review project objective Discuss design approach clarify Prototype development.	M. Rizwan Abdul Basit Minhal			03-oct-24
4	06-11-24	Project Development, Front & Backend. OU eview, NO issued Reports	M. Rizwan Abdul Basit Minhal			
5						
6						
7						
8						
9						

FYP-II Fortnightly Sign-Up Sheet Fall 25



FYP Fortnightly Sign-Up Sheet

Course: ☐ FYP-1 ■ FYP-2 Project Code: FYP-084/FL24 Project Name: SNEAKER VISION

Group Members Names & Regt: Abdul Basit Abbasi (2069-2021) Muhammad Rizwan (2122-2021) Minahil Khan ( )

Supervisor Name: SIR WAQAS PASHA Co-Supervisor's Name: SIR MAAZ AHMED

Meeting #	Date	Agenda (Brief Statement)	Attended By (Student's Name only)	Supervisor's Sign	Co-supervisor's Sign	FYP Officer's Sign
1	20-02-25	Review the progress made in FYP-1 & transition into FYP-2	Abdul Basit Abbasi Muhammad Rizwan Minahil Khan			
2	06-03-25	Discuss the core component of backend	Abdul Basit Muhammad Rizwan Minahil Khan			
3	13-03-25	model Training & Research implementation & Quality Check	Abdul Basit Muhammad Rizwan Minahil Khan			06/03/25
4	10-04-25	Key Performance Indicators, Schedule Regular progress Risk mgmt. etc Plan-	Abdul Basit Abbasi M.Rizwan Minahil Khan			
5	17-04-25	Communication, Planning & problem solving model training + research work, Dataset Testing & implementation & problem solving	Abdul Basit Abbasi Muhammad Rizwan Minahil Khan			
6						
7						
8						
9						

A9. Plagiarism Test Summary Report

Sneaker Thesis Book Final

ORIGINALITY REPORT

11%	9%	2%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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