CHASHMART

Final Year Project

2020-2024

A project submitted in partial fulfillment of the degree of

BS in Computer Science

Submitted to

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Type (Nature of project)	[✓] Development [ ] R&D
Area of specialization	[ ] WebApp [✓] Mobile App [✓] AI based [ ] Embedded System
FYP ID	F-23-Mob-02

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DECLARATION

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Executive Summary

We are working on the development of a mobile application that will change the world of eyewear shopping. The idea is to provide users with best experience by using virtual try-ons. The program uses AI systems to offer advice on what spectacles would suit a person best depending on his or her face shape. The person will be able to try different models of eyewear with the help of virtual try-on. Additionally, there is an option within this app for basic eye tests so users can test their vision essentially finding if any problems were noticed during examination scores may indicate they need see doctor immediately. Our main goal is made possible finding eyeglasses easily with customers living far away areas from cities where there is no eye clinic or optical store around.

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Chapter 1

Introduction & Background

Chapter 1: Introduction

One of the things that has become obvious in today's world is how much we rely on technology for everything and that's why one of the things that many industries and businesses are doing is going digital. For example, firms such as Amazon, Walmart and Alibaba have made it possible for people to buy goods online instead of going to physical stores. The food industry has not been left behind either; it too has seen an increase in the use of websites where customers can place orders for deliveries to be made on their doorsteps. With this application, you can never go wrong when choosing glasses that suit your face shape because among other things, it has an artificial intelligence (AI) system embedded in it whose work is to recommend to you those spectacles which are most likely to look good on you. Also, there are many different styles as well as brands from which these same people will pick any pair(s) they like then to see how each would appear virtually using some kind of model-up stage. For sake of giving advice that is individual needs; we shall consider shapes of faces lest others should buy something unsuitable for them henceforth! But wait…there's more! Being conscious about your eyesight is very important so don't worry about damaging vision just because you aren't sure if it's okay; our app got this covered Background.

1.1. Motivation and Challenges

1.2.1 Motivation

- The application uses system AI (artificial intelligence) to propose the glasses which will most likely suit the user.
- From available types and brands of eyewear's, a person can virtually try on different lenses through virtual models.
- The kinds of styles offered will depend on what is trendy as well as classic because we want our clients to have fashion forward choices too!
- Apart from helping you select that perfect pair we have thought about your health too; don't forget the importance of good eyesight, ok? That's why there is even simple vision test included here already? Don't go anywhere but home sweet home; just relax while testing whether there's need of going for eye checkup or not.

1.2.2 Challenges

- To develop and integrate AI algorithms for face shape detection and AR technology for virtual try-ons, you've got to have sophisticated technical skills.
- Using the Flutter framework, build a robust and user-friendly mobile app that runs on all devices.
- Maintaining user trust requires stringent privacy measures when handling sensitive user data.

1.2. Goals and Objectives

1. To enable quick access of eyeglasses to clients especially those in remote or underprivileged areas where there are few optical facilities.
2. To allow a client try different eyeglass virtually using a 3D model that will be created in Unity and integrated into our Flutter application.
3. To come up with an AI algorithm for detecting and recognizing face shape in order to advice on the best fitting frames for a person’s glasses. To develop a basic vision testing tool that allows users to do basic vision acuity tests, which will help users identify vision impairments and determine if they should visit a doctor based on their test scores.

Overall, the proposed system will help in overcoming some of the problems faced by clients seeking eyewear products and eye care services primarily the cost of traveling and poor access to these premium brands hence reaching out to the marginalized in remote or rural areas.

1.3. Literature Review/Existing Solutions

Yes, there is one such company known as Lens kart However, it is only based in India and is a product. They help users by enabling them to try out glasses virtually. However, the disadvantage of this is that it lacks the feature of recommending to users what they should wear or what is relevant to their dress style. Seamlessly our app, containing an AI algorithm, will scan the face shape of the user and we will suggest the glasses that should fit the user’s face shape and style. Thus, our recommendations are going to be stylist dependent. Thus, the basic functionality of our app is going to be to help users select clothes like a personal stylist.

Table 1 Related System Analysis with proposed project solution for chashmart

Application Name	Weakness	Proposed Project Solution
Lens kart, Peach Mart	Limitations may include limited features, no suggestions.	It is more than just a virtual experience of putting on eyeglasses; our project will also include incorporating artificial intelligence algorithms for recommending the users with the best eyeglasses that will suit their face shape. Therefore, our app will also double for the stylist, and You can do a basic eye test too.

1.4. Gap Analysis

Although the eyewear market does have its distinctive features and trends, there are specific areas that require attention and further development in the context of the growing popularity of digital retail and individualized approaches to sales.

Existing Solutions: Some platforms such as Lens kart allow the user to virtually try on the glasses in terms of looks and feel through augmented reality.

1.5. Proposed Solution

We would be developing a mobile application with a creatively designed user interface through the use of the Flutter framework. This app will develop a catalogue of a broad array of merchandise; where we will have glasses for vision correction like eyeglasses, sunglasses and all other regular eye wear. The user will select a product: and here with different plugins binding a 3d model of a product created using Unity and then integrated into the Flutter application, the user can try it virtually or what is now called augmented reality. We will also include an AI algorithm CLOUD RECOGNITION METHOD (CNN OR KNN MODEL) for identification and recommendation of certain glasses frames suitable uniquely for certain face shapes.

However, it will also present the application known as ‘vision testing application’ which would enable the user to do very simple vision tests with the help of Snellen Charts. The user is typically expected to put the phone down and with the distance sometimes mentioned then those on the phone display is to be read.

This shall help users determine vision disorders and if they require a doctor to attend to them having in mind the findings of the application. All in all, the idea of having an online store for the sales of products such as the eyewear seems to be advantageous to all the players in the process. He pointed out that the app will have the following options: a catalogue of different products including eyeglasses, sunglasses and normal non-vision glasses. The user will choose a product and may 'virtually' 'try it on' M here the 3D model of the product which will be designed in Unity and imported through certain plugins into our Flutter application, be placed over the user's face.

Furthermore, it will also present a concept for a loosely related but very innovative application in vision testing where the user could perform extremely basic eye tests like the ones using Snellen Charts. The user is often expected to step aside from the phone provided the distance is sometimes mentioned then the characters on the phone's screen are to be identified. This will prevent users, allow them to determine the existence of vision impairments, and decide whether they should consult a doctor by using the application results. Summing up, it is possible to note that the existence of an online store for the selling of eyeglasses seems to be profitable for everyone engaged in the process. Hence it provides a valid, effective way in existence because of the current covid 19 situation which has led to the promotion of online shopping.

1.6. Project Plan

It is a detailed written document that depicts the framework for attaining the overall project goals in each time and with available resources available. Trying to let go of what was done in that class, it covers elements like WBS, R&R matrix, time scale, resources, risk and communication plan.

1.6.1 Module 1:

FE-1: This is the place where the users will be able to view and search for different products and in the format of product directory.

1.6.2 Module 2:

FE-1: Checkout processes that involve adding the product to the chart and payment options.

1.6.3 Module 3:

FE-1: Product description upload page, Image upload, Customer's information view panel where admin will be able to manage products with their description and images.

1.6.4 Module 4:

FE-1: The users will be able to try glasses virtually where a 3D AR developed object is illustrated as imposed on the face of the user using live camera feed or a still image.

1.6.5 Module 5:

FE-1: Involving features such as usage of machine learning and deep learning algorithms for recognition and classification of users face shape and after identifying the face shape, the software suggests/recommends appropriate glasses to the user.

1.6.6 Module 6:

FE-1: Our popular and trending products are also going to be listed and will be open to the wants of the user.

FE-2: The user can make a valuation and give feedback regarding a particular product.

1.6.7 Module 7:

FE-1: Users will also assist by our app through the inclusion of color blindness and vision tests. It will only say whether the items are placed correctly or not so that the user can proceed with the eye tests.

FE-2: Digital Snellen chart: this is an easy acuity test where the users are normally required to read from a certain distance that is displayed on the screen.

1.6.8 Module 8:

FE-1: If a user performs poorly based on the eye test score less than the average, then the computer will initiate critical email generate for the user to see a doctor right away.

1.6.9 Module 9:

FE-1: Further, if the user has any query, then he may go through the site's Frequently Asked Questions or he may talk the 'Our volunteer' through the Customer Support chat option.

1.7 Roles & Responsibility Matrix

Table 2 Roles and Responsibilities of project chashmart

Student Name	Student Registration Number	Responsibility/ Module / Feature
Rimsha Ali	202006	Module1 Module 6 Module 9
Muhammad Salman Ahmad	200923	Module 3 Module 5
Fawad Hussain Shah	200824	Module 2 Module 4 Module 7

1.8 Gantt Chart

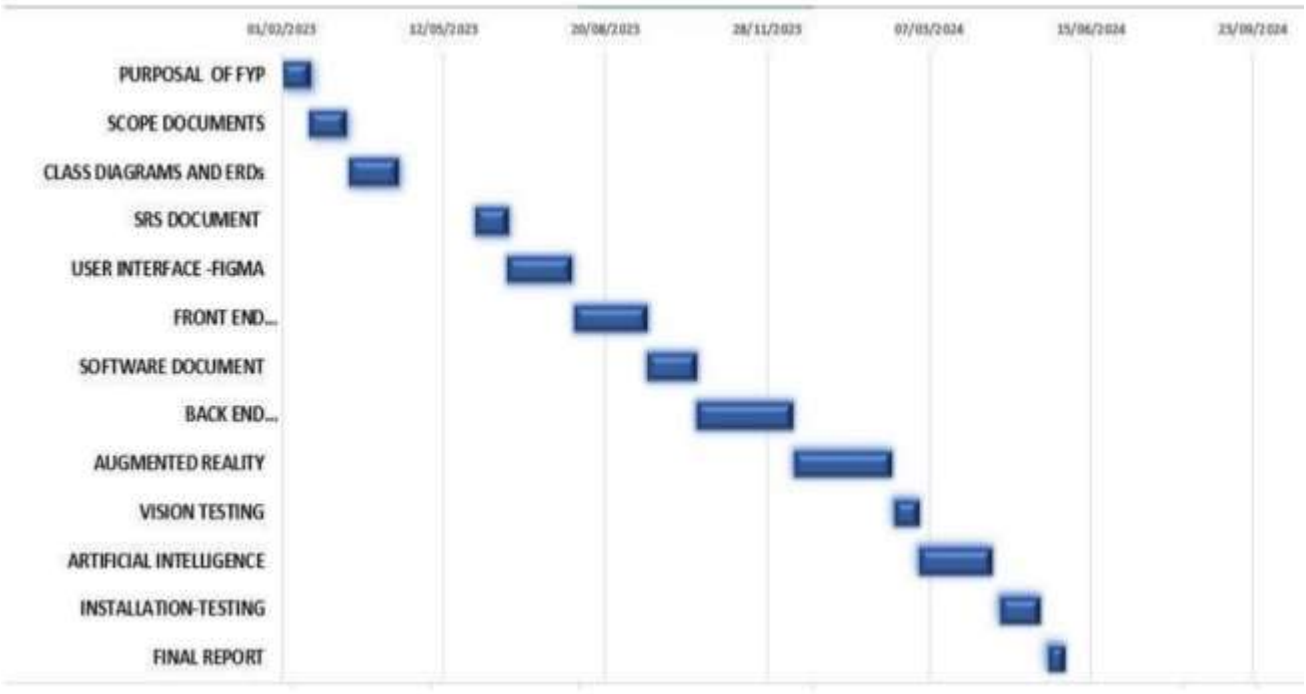

Figure 1 Gantt Chart of project chashmart

Chapter 2

Software Requirement Specifications

Chapter 2: Software Requirement Specifications

2.1 Introduction

2.1.1 Purpose

Our primary goal for the users is to enable them to make purchases effortlessly, trying on glasses from the comfort of their homes. An innovative solution is based on implementing virtual try-ons and adjusting them by an AI algorithm, which will help create a personal AI stylist that prescribes products depending on the users' face shape. This identifies the glasses that enhance specific facial structures, thereby saving customers' wasted hours in selecting the best frames.

We have a more extensive vision that also includes providing solutions to several of the critical issues upsetting not only Pakistan but the world at the large: More specifically, our objectives include eradicating and controlling several forms of eye diseases, which are potentially treatable and leading to curable visual blindness. University of Phoenix strives to make vision care products available to rural areas, assist in getting the right prescription for the frames purchased, and to assist customers in deciding on the glasses that fit properly. Also, by using augmented reality technology, we want our customers to try on sunglasses and see what they would look like on their faces in general. By pursuing such organizational objectives, the organization's goal is to enhance the availability, affordability, and individualization of eye care.

The aim of our project is to encounter these primary challenges:

1. Decreasing the rates of eye diseases and cataract blindness that can be treated in the population of Pakistan.
2. To reach those who remain at the periphery and provide them with an opportunity to buy eye–care products. This video gives information on how to find the right fitting glasses.
3. To fix this issue the customer needs to be able to imagine how it looks on them wearing the glasses.

In this regard, it is essential to note that this document aims at illustrating practical requirements. They also include a description of the workings of the project, its constraints, and its features, the modules, and interfaces. It has been designed with testers, designers, and developers in mind

2.1.2 Document Conventions

Heading 2: Font size 14, bold, Times New Roman, justified alignment.

Heading 3: Font size 12, bold, Times New Roman, justified alignment.

Body Text: Font size 12, Times New Roman, justified alignment.

Bold Text: Used for headings, subheadings, and important terms.

2.1.3 Intended Audience and Reading Suggestions

- To create a clear understanding of 'what' is required from the system in its functional and non-functional aspects and to help guide the design and the implementation process.
- To assist with communication and follow-up of work that is done, project scope and other milestones, including guaranteeing that every need planned to be fulfilled in the project is completed before the timeline gets to a conclusion.
- To understand the special abilities and potential of the app for construction of marketing verbicide and related promotional aids.
- To give a commentary on optimizing the system and to know more about what the outcome of the programmed will entail.
- To be a part of a team that develops test cases while at the same time confirming that the system is developed in accordance with the set specifications.

2.1.4 Product Scope

On the market, one will find Chashmart it is an application and intended as an application for the mobile device that offers try-on different clothes virtually. The application will use face identification algorithms to categorize face shape and the recommended glasses frames. Further, an examination tool that would allow a user to test for prejudicial vision and recommend a doctor's consultation at the earliest opportunity shall be implemented.

2.2 Overall Description

2.2.1 Product Perspective

The goal of this project is to create a platform where users can view, try, and purchase their favorite eye-care products in remote locations where access to quality products is limited. Alternatively, finding and

visiting physical stores is time-consuming and financially burdensome. The primary task is to train a machine learning model that acts as a personal stylist for users, assisting them in finding the ideal fit of glasses that suits their preferences.

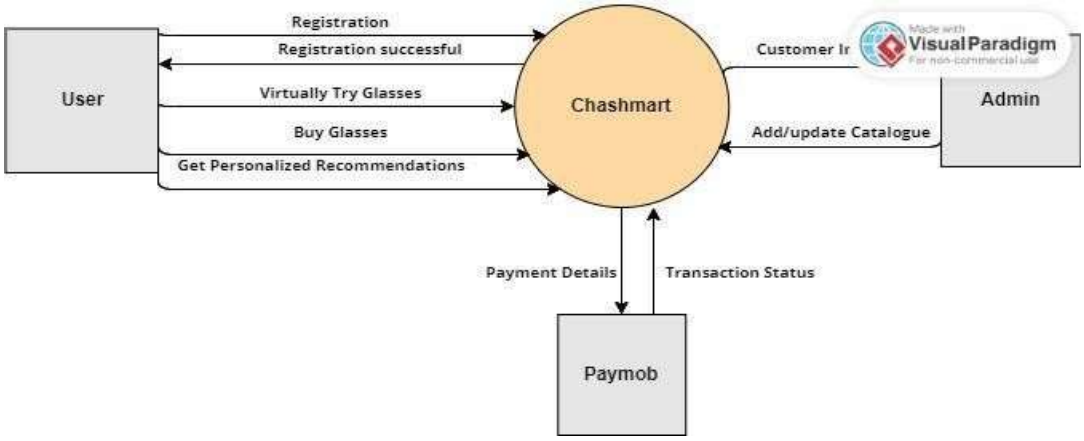

Figure 2 Context diagram of Chashmart

2.2.2 User Classes and Characteristics

Table 3 User Classes and Characteristics of project Chashmart

User class	Description
Admin	The owner and the manager are the administrators of this system, who owns all the records and credentials needed to fill in this system. He can perform following functions: He can perform following functions: 1. Activities of other users 2. Order tracking capabilities 3. Efficient inventory management 4. Add/Update catalog
User	Users are day to day customers, users of e-commerce applications who will be able to perform the following functionalities through our application: Users are day to day customers, users of e-commerce applications who will be able to perform the following functionalities through our application: 1. View and search through different items/ products like glasses and make a purchase. 2. Try glasses virtually 3. Establish baseline of visual acuity.

2.2.3 Operating Environment

This can work on any operating system android or iOS; the trained model will be based on firebase and be accessible via Api's which are provided by firebase ml kit. The data collected would then be saved in Firebase Database from which it can be retrieved later.

OE-1: In that regard, this product shall be compatible with any smart mobile devices namely including operating system like android and iOS.

2.3.4 Design and Implementation Constraints

Instead of 3D models, we are using images to implement virtual try on feature due to the limitations.

CON-1: The system must be based on Flutter SDK as well as the latest Gradle dependencies.

CON-2: AR-core libraries for AR do not work in the latest version of flutter sdk. Some that are there have been deprecated or do not tie up with current versions at all. We shall use Tensor flow lite for deploying our machine learning model which is a mobile library used in models' deployment on mobile, microcontrollers and other edge devices.

Considerations: Design conventions or programming standards (for example, if the customer's organization will be responsible for maintaining the delivered software).

2.3 External Interface Requirements

2.3.1 User Interfaces

References to GUI Standards or Style Guides:

The user interface design will adhere to the Material Design guidelines provided by Google for a modern and consistent look and feel.

Standards for Fonts, Icons, Button Labels, Images, Color Schemes, etc:

Fonts: Roboto will be used for text throughout the application.

Icons: Material Design icons will be implemented for a cohesive visual language.

Button Labels: Clear and concise labels with consistent capitalization and language style.

Images: High-resolution images following a consistent style to enhance the overall aesthetic.

Color Schemes: A primary color palette of green and white, adhering to the app's branding.

Screen Layout or Resolution Constraints:

The app will be designed responsively to accommodate various screen sizes and resolutions, ensuring a seamless experience on both smartphones and tablets.

Standard Buttons, Functions, or Navigation Links:

A persistent navigation bar at the bottom of the screen will include standard buttons for Home, Search, Favorites, and Profile, providing easy access to core functions.

Message Display Conventions/ Push Notifications:

System messages and alerts will be displayed in a consistent manner at the top of the screen, using clear and user-friendly language.in short push notifications.

Layout Standards for Software Localization:

All text elements will be designed with localization in mind, allowing for easy translation without impacting the overall layout. Text expansion considerations will be taken into account.

These characteristics would be detailed in a User Interface Specification document, accompanied by mock-ups illustrating the proposed designs.

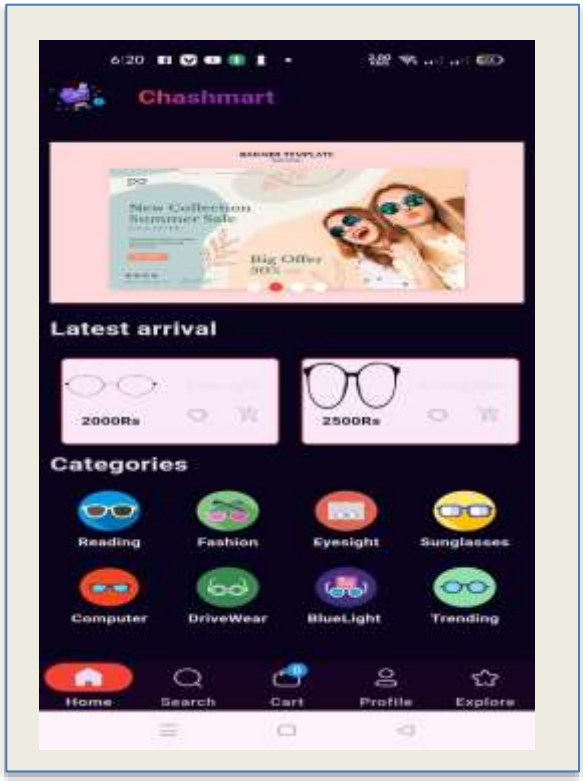

Figure 3 Dashboard Screen of Chashmart

Figure 4 Login Screen of Chashmart

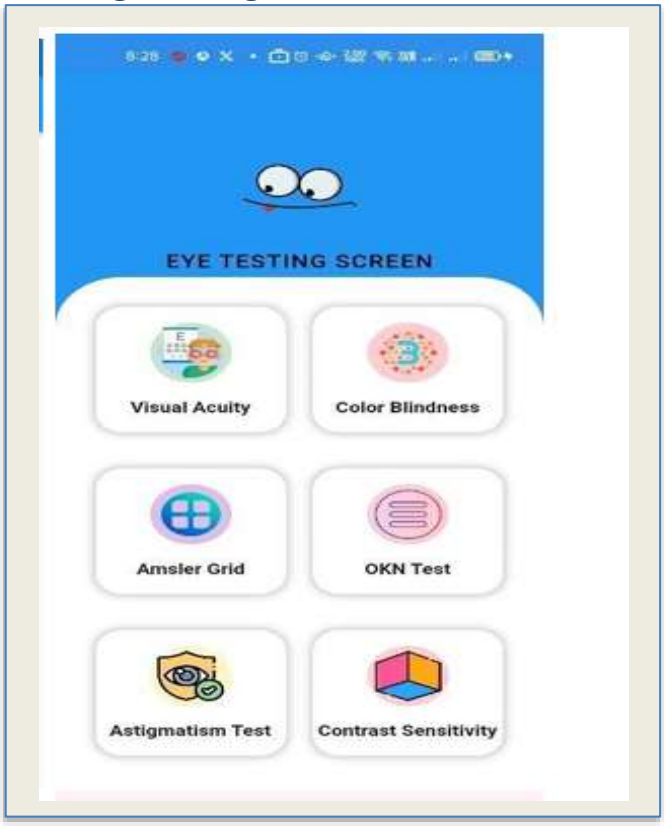

Figure 5 Test Screen of Chashmart

2.3.2. Hardware Interfaces

We require a standard high-resolution image only for the processing, which can be taken from a smartphone or a camera. We suggest using at least these kinds of cameras:

HI-1: Front cameras with a minimum resolution of 720p (HD) or higher. Greater resolutions make AR experiences clearer and more detailed.

HI-2: Ensure that there are at least 30 frames per second (fps) as a minimum frame rate to give smooth and responsive virtual try-on experience.

In addition, we shall need actualized hardware accelerators (GPUs, TPUs) for machine learning model training.

2.3.3 Software Interfaces

System and Model will interact directly with individual libraries such as Machine Learning, AI and payment gateway libraries which include

SI-1: Pandas: This will be used in Preprocessing of data labeling.

SI-2: Pay mob: This will be used as our payment gateway API for handling transactions.

2.3.4 Communications Interfaces

Communication between the Application and the user would not be very high but reasonable based on email priority while disclosing information or requesting permission from users to achieve some aspects below:

CI-1: Email API: Integrate with email services through APIs for sending critical case emails to users.

CI-2: Live Chat Integration: Interface with live chat services using APIs for real-time communication.

CI-4: FAQ Retrieval: Establish communication to retrieve frequently asked questions from a database.

CI-4: Forms (Feedback)

2.4 Functional Requirements

2.4.1 Functional Requirement FR-1

The user can login using his registered email address

Table 4 Functional Requirement FR-1 Sign up

Identifier	FR-001
Title	Sign up
Requirement	1. The system shall request users to enter necessary information during the sign-up process 2. The system shall generate a unique user identifier for each new account.
Source	User
Rationale	Allowing users to create an account to access personalized features, track orders, and receive updates.
Business Rule	None
Dependencies	None
Priority	High

2.4.2 Functional Requirement FR-2

Our system is a diagnoses system which will also be used for data collection.

Table 5 Functional Requirement FR-2 User Authentication

Identifier	FR-002
Title	User Authentication
Requirement	1. Users shall be able to enter email and password to get registered. 2. User shall setup his profile
Source	User
Rationale	To verify and provide access to users.
Business Rule	None
Dependencies	FR-2
Priority	High

2.4.3 Functional Requirement FR-3

The user can login using his registered email address

Table 6 Functional Requirement FR-3 Login via social media

Identifier	FR-003
Title	Login via social media
Requirement	1. Prompt users to enter necessary information during the social media process or show some existing account from their device.
Source	User
Rationale	Enabling users to sign up via social media enhances user experience, promoting a seamless registration process and providing access to tailored features, order tracking, and timely updates.
Business Rule	Must have an account on social media (google, Facebook, twitter)
Dependencies	None
Priority	High

2.4.4 Functional Requirement FR-4

The user can View products in chashmart

Table 7 Functional Requirement FR-4 View Product

Identifier	FR-04
Title	View Product
Requirement	1. The product details shall include, but not be limited to, product name, description, price, images, and availability. 2. Users shall be able to access the product view from the main product listing or search results.
Source	User
Rationale	To allow users to explore and make informed decisions about products by providing comprehensive and accessible product information.
Business Rule	None
Dependencies	None

2.4.5 Functional Requirement FR-5

The user can search product from chashmart

Table 8 Functional Requirement FR-5 Search Product

Identifier	FR-05
Title	Search Product
Requirement	1. The system shall display real-time search suggestions as users type in the search query. 2. Search results shall include relevant product details such as names, descriptions, prices, and images.
Source	User
Rationale	To empower users to efficiently find specific products or explore a range of products based on their preferences.
Business Rule	None
Dependencies	None
Priority	High

2.4.6 Functional Requirement FR-6

The user can view product by category

Table 9 Functional Requirement FR-6 View Product by Category

Identifier	FR-06
Title	View Product by Category
Requirement	1. Users shall be able to access the category view from the main navigation or dedicated category sections and system shall display products within the selected category, like names, descriptions, prices, and images. 2. Users shall be able to click on a product within the category view to access detailed product information.
Source	User
Rationale	To facilitate user exploration and browsing of products within specific categories.
Business Rule	None

2.4.7 Functional Requirement FR-7

The user can seek help from the agent by using Help option

Table 10 Functional Requirement FR-7 User Selects Help Options

Identifier	FR-007
Title	User Selects Help Options
Requirement	1. The application must present the user with options like FAQs and live chat.
Source	User and Agent
Rationale	Different users prefer different support channels; providing options caters to diverse user needs.
Business Rule	Options should be presented in a user-friendly and visually appealing manner.
Dependencies	None
Priority	Medium

2.6.13 Functional Requirement FR-8

The user can update their profile

Table 11 Functional Requirement FR-8 Edit Profile

Identifier	FR-008
Title	Edit Profile
Requirement	1. The user shall be able to edit your credentials.
Source	User
Rationale	Users need the ability to manage and update their profile information as needed for accurate and up-to-date account details.
Business Rule	None
Dependencies	FR-1

2.4.9 Functional Requirement FR-9

The user can rate this app and share their reviews

Table 12 Functional Requirement FR-8 User Rating System

Identifier	FR-009
Title	User Rating System
Requirement	1. The system allows users to rate the Chashmart glasses app on a scale of 1 to 5 stars. 2. Users shall have the option to submit written reviews along with their ratings.
Source	User
Rationale	A user rating system enhances user engagement, provides valuable feedback for app improvement, and influences potential users' decisions.
Business Rule	For every new user acquisition resulting from a friend's app share, the system shall track and associate the referring user with the new user.
Dependencies	None
Priority	Medium

2.4.10 Functional Requirement FR-10

The user can Add to Cart with Color Select and Quantity

Table 13 Functional Requirement FR-10 Add to Cart

Identifier	FR-010
Title	Add to Cart with Color Select and Quantity
Requirement	1. The system shall provide users with the ability to add glasses to their shopping cart directly from the product page. 2. The system shall display a color selection and quantity selector to allow users to specify the desired color and quantity of glasses.
Source	User
Rationale	Enhancing the shopping experience by allowing users to easily customize their order before adding items to the cart.
Business Rule	None
Dependencies	None

2.4.11 Functional Requirement FR-11

The user can purchase from Cart

Table 14 Functional Requirement FR-11 Purchase from Cart

Identifier	FR-011
Title	Purchase from Cart
Requirement	1. Users shall add glasses to the cart with color selection and quantity as specified in FR-007. 2. Upon clicking the "Buy" button, the system shall initiate the checkout process.
Source	User
Rationale	Allowing users to review their selections in the shopping cart before making a purchase.
Business Rule	For every successful purchase, the system shall update the inventory to reflect the reduced quantity of the purchased glasses.
Dependencies	FR-006
Priority	High

2.4.12 Functional Requirement FR-12

The user can add their product to favorite section

Table 15 Functional Requirement FR-12 Add to favorite

Identifier	FR-012
Title	Add to favorite
Requirement	1. The User must search or explore glasses and click on favorite button which glasses they love
Source	User
Rationale	Allowing users to review their favorite glasses when they visit app next time
Priority	High

2.4.13 Functional Requirement FR-13

The user can perform eye test and monitor their visual health

Table 16 Functional Requirement FR-13 Perform Eye Test

Identifier	FR-013
Title	Perform Eye Test
Requirement	1. The eye test shall include assessments for visual acuity, color perception, or other relevant parameters based on the system's intended purpose. 2. Users shall receive clear instructions on how to perform the eye test within the system. 3. The system shall present visual stimuli or tests in a format that is easily understandable and accessible to users. 4. The system shall provide immediate feedback on the results of the eye test to the user.
Source	User
Rationale	To enable users to assess and monitor their visual health, with potential applications in vision correction or healthcare.
Business Rule	None
Priority	Medium To High

2.4.14 Functional Requirement FR-14

The user can use the glasses recommendation feature to find the perfect pair of glasses.

Table 17 Functional Requirement FR-14 Glasses Recommendation

Identifier	FR-014
Title	Glasses Recommendation
Requirement	1. The system shall provide personalized glasses recommendations based on the user's face shape.
Source	User
Rationale	To assist users in making informed decisions about choosing glasses that align with their facial features and preferences.
Business Rule	None
Dependencies	None

2.4.15 Functional Requirement FR-15

The user can logout and lose access to the app.

Table 18 Functional Requirement FR-15 Logout

Identifier	FR-015
Title	Logout
Requirement	1. The User must login and press on logout button
Source	User
Rationale	To take access from users.
Business Rule	None
Dependencies	FR-1
Priority	Low

2.4.16 Functional Requirement FR-16

The admin can login to access the app

Table 19 Functional Requirement FR-16 Admin login

Identifier	FR-016
Title	Admin Login
Requirement	1. Administrators shall be required to enter valid credentials, including a unique username and password. 2. The system shall authenticate administrator credentials against stored information in the admin database. 3. An error message shall be displayed if the entered credentials are incorrect or if the administrator account does not exist. 4. Administrators shall be granted access only if the entered credentials are verified successfully.
Source	Admin
Rationale	To ensure secure access to the admin panel for authorized administrators, allowing them to manage and configure system settings.
Business Rule	None
Dependencies	None

2.4.17 Functional Requirement FR-17

The admin can view detail of any product

Table 20 Functional Requirement FR-17 View Product

Identifier	FR-017
Title	View Products
Requirement	1. Admins shall be able to access the product details from the admin panel. 2. The system shall display product information in a clear and user-friendly format within the admin panel. 3. Admins shall be able to search for specific products and view their details efficiently.
Source	Admin
Rationale	To enable administrators to oversee and manage product information within the system, ensuring accuracy and relevance.
Dependencies	FR-16
Priority	High

2.4.18 Functional Requirement FR-18

The admin can add product

Table 21Functional Requirement FR-18 Add Products

Identifier	FR-018
Title	Add Products
Requirement	1. The system shall prompt administrators to enter essential product details, including name, description, price, images, and availability. 2. Admins shall receive confirmation upon successful addition of a new product.
Source	Admin
Rationale	To empower administrators to expand the product catalog within the system.
Business Rule	None

2.4.19 Functional Requirement FR-19

The admin can update details of any product.

Table 22 Functional Requirement FR-19 Update Product

Identifier	FR-019
Title	Update Product
R requirement	1. Admins shall access the "Update Product" feature within the admin panel. 2. The system shall display a list of current products, allowing admins to select the product they want to update. 3. Admins shall be able to upload new images or multimedia files for the updated product.
Source	Admin
Rationale	To enable administrators to keep product information accurate and relevant, reflecting changes in pricing, availability, or other details.
Dependencies	FR-16
Priority	High

2.4.20 Functional Requirement FR-20

The admin can delete product

Table 23 Functional Requirement FR-20 Delete Product

Identifier	FR-020
Title	Delete Product
Requirement	1. Admins shall be prompted for confirmation before the deletion of a product to prevent accidental removal. 2. Admins shall receive confirmation upon successful deletion of a product.
Source	Admin
Rationale	To allow administrators to manage the product catalog by removing obsolete or discontinued items.
Business Rule	None
Dependencies	FR-16

2.4.21 Functional Requirement FR-21

Then admin can logout from app

Table 24 Functional Requirement FR-21 Admin Logout

Identifier	FR-021
Title	Admin Logout
Requirement	1. Admins shall access the "Logout" feature within the admin panel. 2. The system shall terminate the admin session upon clicking the "Logout" option. 3. Admins shall be redirected to the login screen or a designated home screen upon successful logout. 4. Admins shall not be able to access admin panel features after successful logout until they log in again.
Source	Admin
Rationale	To ensure the security that prevent unauthorized access to admin functionalities.
Business Rule	None
Dependencies	FR-16
Priority	High

2.5 Nonfunctional Requirements

2.5.3 Performance Requirements

P-1: When you try on glasses in 3D, the time it takes for the app to respond should be between 15 to 20 seconds on average.

P-2: The number of mistakes or errors in the app should be less than 20% to ensure a reliable experience.

P-3: The different copies or instances of the app should be well-optimized, meaning they run efficiently without unnecessary use of resources.

P-4: The app should not rely too heavily on the computer's processing power (CPU) or graphics processing power (GPU) to ensure it runs smoothly on a variety of devices.

P-5: Implement lazy loading for non-essential components and features to prioritize critical functionality during app startup.

2.5.4 Security Requirements

S-1: User data, including facial images from the 3D try-on, should be encrypted, and stored securely toprotect user privacy.

S-2: The AI suggestion system should adhere to data protection standards, ensuring that user preferencesare managed confidentially.

S-3: The app should implement secure authentication methods to prevent unauthorized access tosensitive user information

S-4: Implement secure coding practices, including input validation and proper error handling.

S-5: Encrypt sensitive data stored locally on the device using Flutter's secure storage mechanisms.

S-6: Implement and regularly update security rules for Firebase Real-time Database and Fire store.

S-7: Secure Firebase Cloud Functions by restricting execution and authorizing specific actions.

Chapter 3

Use Case Analysis

Chapter 3: Use Case Analysis

Use Case Analysis is a chapter dedicated to dissecting the functional requirements of a system by identifying and defining its use cases. It serves as a fundamental step in understanding how users interact with the system and the specific functionalities it must provide to meet their needs. Use cases are narratives that outline various scenarios or interactions between users and the system, capturing the goals, actions, and outcomes involved.

3.1. Use Case Model

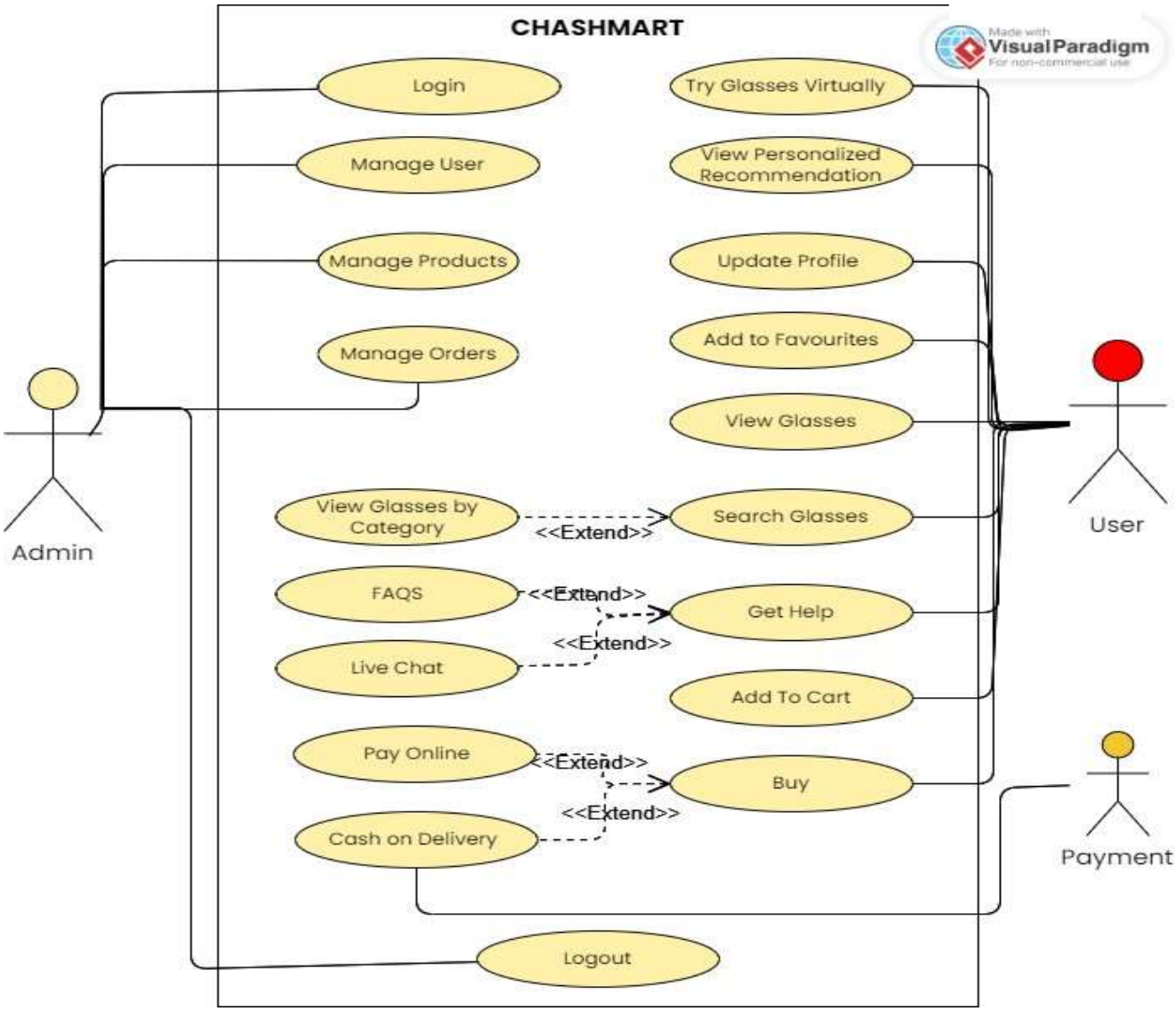

Figure 6 Use case Diagram of Chashmart

3.2. Use Cases Description

3.2.1 use case UC-001

Table 25 Use Case UC-001 Sign-Up

Use Case ID:	UC-001
Use Case Name:	Sign-Up
Primary Actors:	User Firebase Authentication System
Description:	This use case describes the process of a user signing up for a mobile application using theiremail and password.
Trigger:	The user launches the mobile application and selects the email/password sign-up option.
Preconditions:	PRE-1: The user has the mobile application installed. PRE-2: Users click on sign up button from splash screen
Postconditions:	POST-1: The user is successfully registered and logged into the application.POST-2: The application navigates to the user's dashboard.
Normal Flow:	1. The application presents a sign-up form with fields for email, password, and confirmpassword. 2. the registration data to FirebaseAuthentication for user creation. 3. Firebase Authentication verifies the user's credentials and creates a new user account.
Exceptions:	If the entered registration data is invalid or incomplete, the application notifies the user andprompts them to correct the information.
Business Rules	Usernames must be unique within the application.
Assumptions:	More than 100 users can Sign up to their profile at a time.

3.2.2 use case UC-002

Table 26 Use Case UC-002 Login

Use Case ID:	UC-002
Use Case Name:	Login
Primary Actors:	User Firebase Authentication system
Description:	Existing users log in to the system using their registered email and password to accesspersonalized features and information.
Trigger:	The user clicks on the login button from the default home screen.
Preconditions:	PRE-1: User has a registered account
Postconditions:	POST-1: User successfully logs in and gains access to their account.POST-2: The application navigates to the user's dashboard.
Normal Flow:	1. The user opens the mobile application. 2. If the user is not already logged in, they select the login option. 3. The application prompts the user to enter their login credentials. 4. The user enters their login credentials. 5. Firebase Authentication verifies the credentials. 6. Upon successful verification, the user is granted access, and the application navigatesto the user's dashboard.
Alternative Flows:	1. Users click on the button to log in via Google, Facebook, or Twitter.
Exceptions:	The system displays an error message prompting the user to check their email or register.System displays an error message and prompts the user to enter the correct password.
Business Rules	Email must in the correct format
Assumptions:	More than 100 users can login to their profile at a time.

3.2.3 use case UC-003

Table 27 Use Case UC-003 Login via social media

Use Case ID:	UC-003
Use Case Name:	Login via social media
Primary Actors:	User Firebase
Description:	This use case describes the process of a user logging into a mobile application using theirsocial media accounts on Twitter, Google, or Facebook.
Trigger:	The user launches the mobile application and clicks on the button
Preconditions:	PRE-1: The user has the mobile application installed. PRE-2: The user has an active Twitter, Google, or Facebook account.
Postconditions:	POST-1: User successfully logs in and gains access to their account
Normal Flow:	1. The user opens the mobile application. 2. The user selects the option to log in via social media. 3. The application displays button logo of available social media platforms (Twitter,Google, Facebook), user chooses one of the platforms.
Alternative Flows:	1. If the user cancels the social media login process, they are redirected back to theapplication without authentication. 2. The application informs the user that the login was canceled.
Exceptions:	If the social media authentication fails (e.g., due to invalid credentials), the applicationnotifies the user and prompts them to retry.
Business Rules	The application should comply with the authentication guidelines and policies of therespective social media platforms.
Assumptions:	More than 100 users can login to their profile at a time.

3.2.4 use case UC-004

Table 28 Use Case UC-004 View Products

Use Case ID:	UC-004
Use Case Name:	View Products
Primary Actors:	User Mobile Application
Description:	This use case outlines the process of a user viewing a list of products in the Chashmartplatform.
Trigger:	The user wants to explore and browse available products.
Preconditions:	PRE-1: The user is logged into the Chashmart platform.
Postconditions:	POST-1: The user has successfully viewed the list of products.
Normal Flow:	1. The user navigates to the "Products" or "Shop" section within the Chashmart platform. 2. Within the product section, the user is presented with a list of available products, including relevant details such as product names, descriptions, prices, and images. 3. The user can click on a specific product to view more detailed information.
Alternative Flows:	1. If the user encounters difficulties in navigating or accessing product details, thesystem offers guidance or support options.
Exceptions:	1. If there are technical issues preventing the retrieval of product information, the system displays an error message and advises the user to try again or contact customer support. 2. In cases where the product data is temporarily unavailable or incomplete, the system informs the user about the issue and suggests alternative actions.
Business Rules	None.
Assumptions:	The user has successfully logged into the Chashmart.

3.2.5 use case UC-005

Table 29 Use Case UC-005 Search for Products

Use Case ID:	UC-005
Use Case Name:	Search for Products
Primary Actors:	User Mobile Application
Description:	This use case outlines the process of a user searching for specific products in the Chashmartplatform.
Trigger:	The user wants to find and explore products.
Preconditions:	PRE-1: The user is logged into the Chashmart platform.
Postconditions:	POST-1: The user has successfully searched for and found relevant products.
Normal Flow:	1. The user navigates to the search bar or dedicated search section within the Chashmartplatform. 2. The user enters search queries, such as product names, keywords, or categories. 3. The system dynamically updates the search results in real-time based on the enteredqueries, displaying relevant products. 4. The user can click on a specific product in the search results to view more detailedinformation.
Alternative Flows:	1. If the user's initial search yields no results, the system may suggest related productsor provide search term suggestions to enhance the user experience.
Exceptions:	If there are technical issues preventing the execution of the search function, the systemdisplays an error message and advises the user to try again or contact customer support.
Business Rules	None.
Assumptions:	The user has successfully logged into the Chashmart platform. The search system is capable of providing relevant and accurate results.

3.2.6 use case UC-006

Table 30 Use Case UC-006 View Products By Category

Use Case ID:	UC-006
Use Case Name:	View Products by Category
Primary Actors:	User Mobile Application (Chashmart)
Description:	This use case outlines the process of a user viewing a list of products within a specificcategory in the Chashmart platform.
Trigger:	The user wants to explore products within a particular category.
Preconditions:	PRE-1: The user is logged into the Chashmart platform.
Postconditions:	POST-1: The user has successfully viewed the list of products within the selected category.
Normal Flow:	1. The user navigates to the "Categories" or "Shop by Category" section within theChashmart platform. 2. Within the category section, the user selects a specific category of interest (e.g.,prescription glasses, fashion glasses). 3. The system displays a list of products within the selected category, including relevantdetails such as product names, descriptions, prices, and images. 4. The user can click on a specific product to view more detailed information.
Alternative Flows:	None.
Exceptions:	1. If there are technical issues preventing the retrieval of category-specific product information, the system displays an error message and advises the user to try again or contact customer support.
Business Rules	None.
Use Case ID:	UC-06

3.2.7 use case UC-007

Table 31 Use Case UC-007 Accessing Help Center

Use Case ID	UC-007
Use Case Name:	Accessing Help center
Primary Actors:	User Customer Support Representative
Description:	This use case involves a user seeking assistance or information from customer support.
Trigger:	The user initiates the help request by selecting the "Help" option within the application.
Preconditions:	PRE-1: The user has the mobile application installed.
Postconditions:	POST-1: The user receives the necessary assistance or information.POST-2: If necessary, the user's issue is logged for further analysis.
Normal Flow:	1. The user opens the mobile application. 2. The user navigates to the "Help" section within the application. 3. The application presents options for the user to choose from, such as FAQs, live chat. 4. If the user chooses live chat, the application connects them with a customer supportrepresentative.
Exceptions:	If there is a system outage or maintenance affecting customer support services, theapplication informs the user about the unavailability of help.
Business Rules	Customer support inquiries should be addressed within a specified timeframe. The application should provide clear and concise information in response to help requests.
Assumptions:	Customers contact our agent successfully.

3.2.8 use case UC-008

Table 32 Use Case UC-008 Update Personal Details in Profile

Use Case ID	UC-008
Use Case Name:	Update Personal Details in Profile
Primary Actors:	User Mobile Application Firebase Authentication System
Description:	This use case describes the process of a user updating their personal details, such as usernameand email and password in the profile on Firebase.
Trigger:	The user wants to modify their personal details.
Preconditions:	PRE-1: The user is logged into the mobile application. PRE-2: Click on top menu button from dashboard and select edit profile
Postconditions:	POST-1: The user's personal details are successfully updated in Firebase.
Normal Flow:	1. The user accesses the dashboard and clicks on the "Edit Profile" link or button. 2. The user makes changes to the desired fields, such as name, email, password. 3. The system sends a confirmation message to the user, indicating that the profile hasbeen successfully updated.
Alternative Flows:	1. If the user decides not to select any button, they can remain on the dashboard.
Exceptions:	If the user decides not to select any button, they can remain on the dashboard
Business Rules	None
Assumptions:	Users click on the log out button and log out successfully.

3.2.9 use case UC-009

Table 33 Use Case UC-009 User Can Rate and Review

Use Case ID	UC-009
Use Case Name:	User can Rate and Review
Primary Actors:	User Mobile Application Firebase Authentication System
Description:	This use case describes the process of a user rating and reviewing content within the mobileapplication.
Trigger:	The user wants to provide a rating and review for specific content.
Preconditions:	PRE-1: The user is logged into the mobile application. PRE-2: The user is on the page or screen where the content to be rated and reviewed isaccessible.
Postconditions:	POST-1: The user's rating and review are successfully submitted and stored in the system.
Normal Flow:	1. The user navigates to the rate and review from Dashboard. 2. The user selects the option to rate and review the content. 3. The system presents a form for the user to input their rating and compose a review. 4. If the data is valid, the system stores the user's rating and review for the specificcontent.
Alternative Flows:	1. If the user decides not to provide a rating and review, they can navigate away fromthe rating and review interface.
Exceptions:	If there are issues with the submission the system should provide appropriate error messagingand allow the user to retry.
Business Rules	None
Assumptions:	Users click on the log out button and log out successfully.

3.2.10 use case UC-010

Table 34 Use Case UC-010 Add Glasses to Cart

Use Case ID	UC-010
Use Case Name:	Add Glasses to Cart
Primary Actors:	User Mobile Application Firebase Authentication System
Description:	This use case describes the process by which a customer adds a specific pair of glasses totheir shopping cart with the ability to select the quantity and color.
Trigger:	The customer wants to add glasses to their shopping cart.
Preconditions:	PRE-1: The user is logged into the mobile application. PRE-2: The user has selected a specific type of glasses (e.g., polygon, square) from thedashboard. PRE-3: The user has clicked on the details of a specific pair of glasses.
Postconditions:	POST-1: The system adds the selected glasses to the shopping cart.
Normal Flow:	1. The customer navigates to the glass's product page. 2. The customer selects the desired quantity. 3. The customer clicks on the "Add to Cart" button. 4. The system adds the selected glasses to the shopping cart.
Alternative Flows:	1. If the customer attempts to add glasses with invalid or insufficient information, thesystem displays an error message.
Exceptions:	If there are technical issues preventing the addition of glasses to the cart, the system displaysan error message.
Business Rules	None
Assumptions:	The system adds the selected glasses to the shopping cart Successfully.

3.2.11 use case UC-011

Table 35 Use Case UC-011 Buy Glasses

Use Case ID	UC-011
Use Case Name:	Buy Glasses
Primary Actors:	Mobile Application Firebase Authentication System
Description:	This use case describes the process by which a customer proceeds to buy the selected glassesafter adding them to the shopping cart.
Trigger:	The customer wants to proceed with the purchase of selected glasses.
Preconditions:	PRE-1: The user is logged into the mobile application. PRE-2: The user has selected a specific type of glasses (e.g., polygon, square) from thedashboard.
Postconditions:	POST-1: The system adds the selected glasses to the shopping cart.
Normal Flow:	1. The customer clicks on the shopping cart icon or navigates to the cart page. 2. The system displays the contents of the shopping cart, including the selected glasses,quantity, and total price. 3. The customer reviews the cart and clicks on the "Proceed to Checkout" button. 4. The customer receives an email confirmation of the order.
Alternative Flows:	1. If the customer attempts to add glasses with invalid or insufficient information, thesystem displays an error message.
Exceptions:	If the payment is declined or there's an issue with the transaction, the system provides anerror message and allows the customer to retry or choose an alternative payment method.
Business Rules	None
Assumptions:	The 100 users placed an order of glasses Successfully.

3.2.12 use case UC-012

Table 36 Use Case UC-012 Add to Favorites

Use Case ID	UC-012
Use Case Name:	Add to Favorites
Primary Actors:	User Mobile Application
Description:	This use case involves users adding products to their list of favorites for quick access andfuture reference.
Trigger:	The user initiates the process of adding a product to their favorites by selecting the "Add toFavorites" option within the application.
Preconditions:	PRE-1: The user has the mobile application installed.
Postconditions:	POST-1: The selected product is successfully added to the user's list of favorites.
Normal Flow:	1. The user opens the mobile application. 2. The user navigates to the product page containing the item they want to add to theirfavorites. 3. The user receives a confirmation message indicating that the product has been addedto their favorites.
Exceptions:	If there is an issue with the server or network connectivity during the addition process, theapplication informs the user about the problem and suggests trying again later. If the selected product is no longer available or has been discontinued, the application notifiesthe user and may provide alternative recommendations.
Business Rules	The user's favorites list should be stored securely and associated with their account.Users can review and manage their list of favorites at any time.
Assumptions:	Users can add a reasonable number of products to their favorites list.

3.2.13 use case UC-013

Table 37 Use Case UC-013 Perform Eye Test

Use Case ID	UC-013
Use Case Name:	Perform Eye Test
Primary Actors:	User Eye Test Module
Description:	This use case involves users performing basic eye tests within the mobile application to assesstheir vision. Based on the test results, users receive a report and are notified if they need to visit a doctor urgently.
Trigger:	The user initiates the eye test by selecting the "Eye Test" option within the application.
Preconditions:	PRE-1: The user has the mobile application installed.
Postconditions:	POST-1: The user receives their eye test results. POST-2: If necessary, the user is notified about the urgency of visiting eye doctor.
Normal Flow:	1. The user opens the mobile application. 2. The user navigates to the "Eye Test" section within the application. 3. If the test results indicate a potential problem, the application notifies the user through email about the urgency of visiting an eye doctor for a thorough examination.
Exceptions:	If there is a technical issue preventing the accurate assessment of the user's eye test, the application informs the user about the problem and may prompt them to try the test again orseek professional advice.
Business Rules	The application should encourage users to visit an eye doctor for a complete eye healthevaluation, especially if any issues are detected during the screening.
Assumptions:	The application does not replace the expertise of an eye care professional, and users areencouraged to seek professional advice for any concerns.

3.2.14 use case UC-014

Table 38 Use Case UC-014 Glasses Recommendation

Use Case ID	UC-014
Use Case Name:	Glasses Recommendation
Primary Actors:	User Recommendatio n SystemGlasses Database
Description:	This use case involves the recommendation system suggesting glasses to users based on theirface shape.
Trigger:	The user initiates the glasses recommendation process by selecting the "GlassesRecommendation" option within the application.
Preconditions:	PRE-1: The user has the mobile application installed.
Postconditions:	POST-1: The user receives personalized glasses recommendations based on their face shape.
Normal Flow:	1. The user opens the mobile application. 2. The user navigates to the "Glasses Recommendation" section within the application. 3. with a database ofglasses styles suitable for different face shapes. 4. The user can view details and images of the recommended glasses, including brand,style, and price. 5. The user has the option to purchase the recommended glasses directly through theapplication or explore more options.
Assumptions:	The accuracy of the glasses recommendations is influenced by the quality of the user-provided photo. Users are expected to consider additional factors such as personal style and comfort whenmaking final purchasing decisions.

3.2.15 use case UC-015

Table 39 Use Case UC-015 Logout

Use Case ID	UC-014
Use Case Name:	log out
Primary Actors:	User Mobile Application Firebase Authentication System
Description:	This use case describes the process by which a customer proceeds to buy the selected glassesafter adding them to the shopping cart.
Trigger:	The user decides to log out of the application.
Preconditions:	PRE-1: The user is logged into the mobile application.
Postconditions:	POST-1: The user is no longer authenticated and has successfully logged out of theapplication.
Normal Flow:	1. The user navigates to the profile section of the application. 2. Within the profile section, the user locates the "Logout" option. 3. The user clicks on the "Logout" button. 4. The system logs the user out, terminating the current session. 5. The application returns to the login or home screen, indicating that the user has beensuccessfully logged out.
Alternative Flows:	1. If the user is engaged in an activity or has unsaved changes, the system may promptthe user to confirm the logout action to avoid accidental logouts.
Exceptions:	There are technical issues preventing the logout, the system displays an error message andadvises the user to try again.
Business Rules	None
Assumptions:	User Logout Successfully.

3.2.16 use case UC-016

Table 40 Use Case UC-016 Admin login

Use Case ID:	UC-016
Use Case Name:	Admin Login
Primary Actors:	Admin Firebase Authentication system
Description:	This use case describes the process by which an Admin can login and access the AdminPortal.
Trigger:	The admin clicks on the login button from the default home screen.
Preconditions:	PRE-1: Admin has a registered account
Postconditions:	POST-1: Admin successfully logs in and gains access to their account.POST-2: The application navigates to the admin's dashboard.
Normal Flow:	1. The admin opens the admin portal. 2. If the admin is not already logged in, he/she can select the login option. 3. The application prompts the admin to enter their login credentials. 4. The admin enters their login credentials. 5. The application sends the login credentials to Firebase Authentication forverification. 6. Firebase Authentication verifies the credentials. 7. Upon successful verification, the admin is granted access, and the applicationnavigates to the admin's dashboard.
Alternative Flows:	None.
Exceptions:	The system displays an error message prompting the admin to check their email or register. System displays an error message and prompts the user to enter the correct password.
Business Rules	Email must in the correct format
Assumptions:	Only the Admin can access his portal.

3.2.17 use case UC-017

Table 41 Use Case UC-017 View Products

Use Case ID	UC-017
Use Case Name:	View Products
Primary Actors:	Admin, Inventory Management System
Description:	This use case outlines the process of an admin viewing a list of products in theChashmart platform.
Trigger:	The admin wants to review and manage existing products.
Preconditions:	PRE-1: The admin is logged into the Chashmart Admin Panel.
Postconditions:	POST-1: The admin has successfully viewed the list of products.
Normal Flow:	1. The admin navigates to the "Product Management" section in the admin panel. 2. Within the "Product Management" section, the admin selects the option to"View Products." 3. The system displays a list of existing products, including relevant details suchas product names, descriptions, prices, and quantities. 4. The admin can click on a specific product to view more detailed information.
Alternative Flows:	None.
Exceptions:	If there are technical issues preventing the retrieval of product information, the systemdisplays an error message and advises the admin to try again.
Business Rules	None
Assumptions:	The admin has the necessary privileges to view product details.

3.2.18 use case UC-018

Table 42 Use Case UC-018 Add a New Product

Use Case ID	UC-018
Use Case Name:	Add a New Product
Primary Actors:	Admin, Inventory Management System
Description:	This use case outlines the process of an admin adding a new product to the online store'sinventory.
Trigger:	The admin decides to add a new product to the inventory.
Preconditions:	PRE-1: The user is logged into the Chashmart Admin Panel.
Postconditions:	POST-1: The new product is successfully added to the inventory.
Normal Flow:	1. The admin navigates to the "Product Management" section in the admin panel. 2. Within the "Product Management" section, the admin selects the option to"Add New Product." 3. Product information and clicks the "AddProduct" button. 4. The system validates the entered information and adds the new product to theinventory. 5. The admin panel displays a confirmation message indicating that the producthas been successfully added.
Alternative Flows:	1. If the admin tries to add a product with incomplete or invalid information, thesystem prompts the admin to correct the errors before proceeding.
Exceptions:	If there are technical issues preventing the addition of the new product, the systemdisplays an error message and advises the admin to try again.
Business Rules	None
Assumptions:	The admin has the necessary privileges to add products to the inventory, and the productdetails provided are accurate.

3.2.19 use case UC-019

Table 43 Use Case UC-019 Update Product Details

Use Case ID	UC-019
Use Case Name:	Update Product Details
Primary Actors:	Admin Inventory Management System
Description:	This use case outlines the process of an admin updating the details of an existing product in the chashmart inventory.
Trigger:	The admin decides to modify the details of a specific product in the inventory.
Preconditions:	PRE-1: The admin is logged into the admin panel of the inventory management system. PRE-2: The product to be updated already exists in the inventory.
Postconditions:	POST-1: The product details are successfully updated in the inventory.
Normal Flow:	1. The admin navigates to the "Product Management" section in the admin panel. 2. Within the "Product Management" section, the admin selects the option to"Update Product." 3. The system provides a list of existing products for the admin to choose theproduct they want to update. 4. The admin selects the desired product from the list. 5.
Alternative Flows:	1. If the admin tries to update a product with incomplete or invalid information,the system prompts the admin to correct the errors before proceeding.
Exceptions:	If there are technical issues preventing the update of the product details, the systemdisplays an error message and advises the admin to try again.
Assumptions:	The admin has the necessary privileges to update product details, and the modifiedinformation provided is accurate.

3.2.20 use case UC-020

Table 44 Use Case UC-020 Delete Product

Use Case ID	UC-020
Use Case Name:	Delete Product
Primary Actors:	Admin Inventory Management System
Description:	This use case outlines the process of an admin deleting a product from the Chashmart'sinventory.
Trigger:	The admin decides to remove a specific product from the inventory.
Preconditions:	PRE-1: The admin is logged into the admin panel of the inventory management system.
Postconditions:	The product is successfully deleted from the inventory.
Normal Flow:	1. The admin navigates to the "Product Management" section in the admin panel. 2. Within the "Product Management" section, the admin selects the option to"Delete Product." 3. The system provides a list of existing products for the admin to choose theproduct they want to delete. 4. The admin selects the desired product from the list. 5. The application displays a confirmation message indicating that the producthas been successfully deleted.
Alternative Flows:	1. If the admin accidentally selects the wrong product for deletion, the systemprovides a confirmation prompt to prevent accidental deletions.
Exceptions:	If there are technical issues preventing the deletion of the product, the system displaysan error message and advises the admin to try again.
Business Rules	None
Assumptions:	The admin has the necessary privileges to delete products from the inventory, and thedeletion action is intentional.

3.1.21 use case UC-021

Table 45 Use Case UC-021 Logout Admin

Use Case ID	UC-021
Use Case Name:	Logout Admin
Primary Actors:	Admin Panel
Description:	This use case describes the process by which an admin logs out from the Chashmartadmin panel.
Trigger:	The admin decides to log out of the admin panel.
Preconditions:	PRE-1: The admin is currently logged into the admin panel.
Postconditions:	POST-1: The admin is no longer authenticated and has successfully logged out of theadmin panel.
Normal Flow:	1. The admin navigates to the profile or settings section within the admin panel. 2. Within the profile or settings section, the admin locates the "Logout" option. 3. The admin clicks on the "Logout" button. 4. The system logs the admin out, terminating the current admin session. 5. The admin is redirected to the login screen or a landing page, indicating thatthe logout was successful.
Alternative Flows:	1. If the admin is engaged in an activity or has unsaved changes, the system mayprompt the admin to confirm the logout action to avoid accidental logouts.
Exceptions:	If there are technical issues preventing the logout, the system displays an error messageand advises the admin to try again.
Business Rules	None

Chapter 4
System Design

Chapter 4: System Design

The System Design chapter serves as a blueprint for constructing the system, detailing its architecture, components, and interactions. It encompasses various diagrams and models to depict the structure and behavior of the system, ensuring clarity and alignment with the project requirements and objectives.

4.1. Data Flow Diagram

A Data Flow Diagram (DFD) illustrates the flow of data within a system, highlighting how information is processed and transferred between different entities and processes. It typically includes external entities (actors), processes, data stores, and data flows. For the Chashmart system, the DFD demonstrates how users interact with the app for registering, searching for products, virtually trying on eyewear, receiving AI-based recommendations, and completing purchases, including the payment processing with the bank. This visual representation helps identify the functional flow and data management in the system.

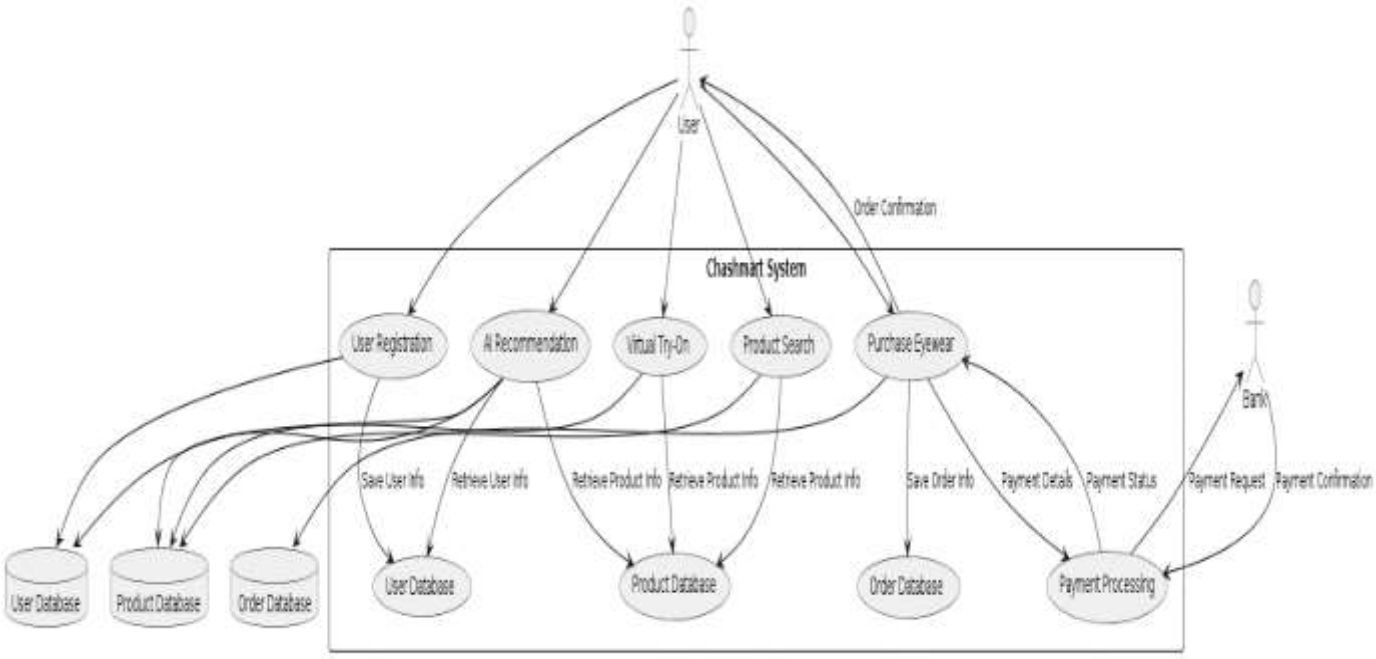

Figure 7 Data Flow Diagram of Chashmart

4.2. Architecture Diagram

The architecture diagram for the "Chashmart" app comprises four layers:

Presentation Layer (Mobile App)

Application Layer (User Service, Product Service, Cart Service, Order Service, Chat Service, AR Feature Service, AI Recommendation Service, Rating Service)

Data Access Layer (User Database, Product Database, Order Database, Chat Database, Rating Database)

External Services (Payment Gateway, AR Engine, AI Model Service).

These layers interact to facilitate user interactions, business logic, data storage, and integration with external functionalities, ensuring a seamless and feature -rich experience for users.

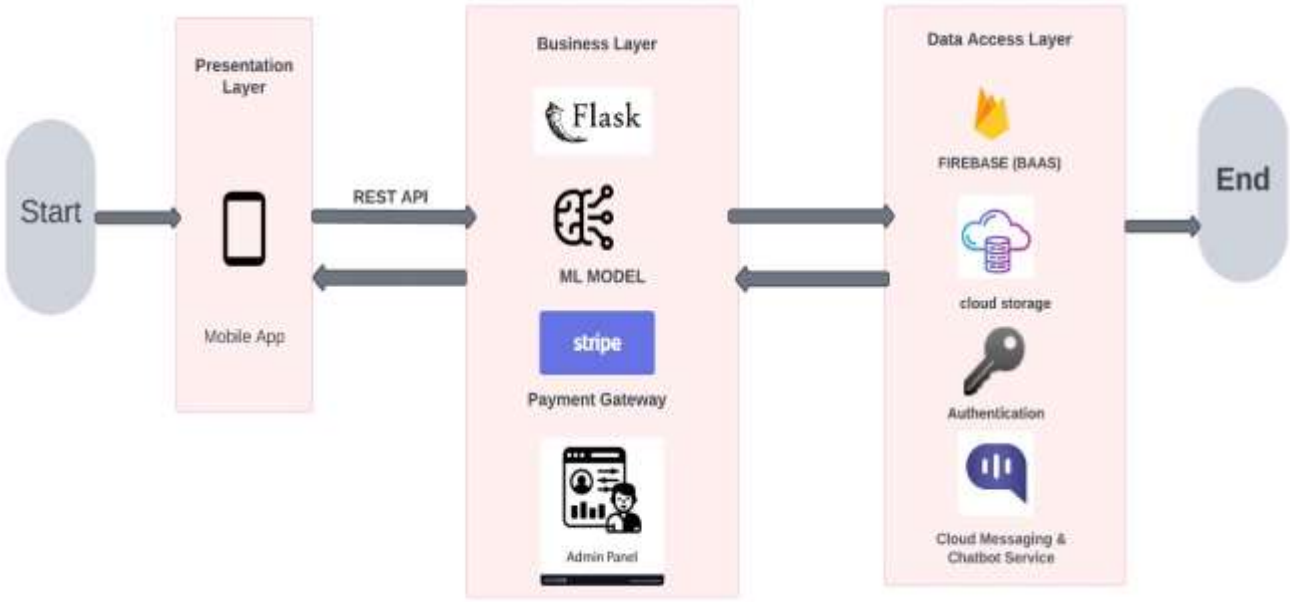

Figure 8 Architecture Diagram of Chashmart

4.3. Entity Relationship Diagram with data dictionary

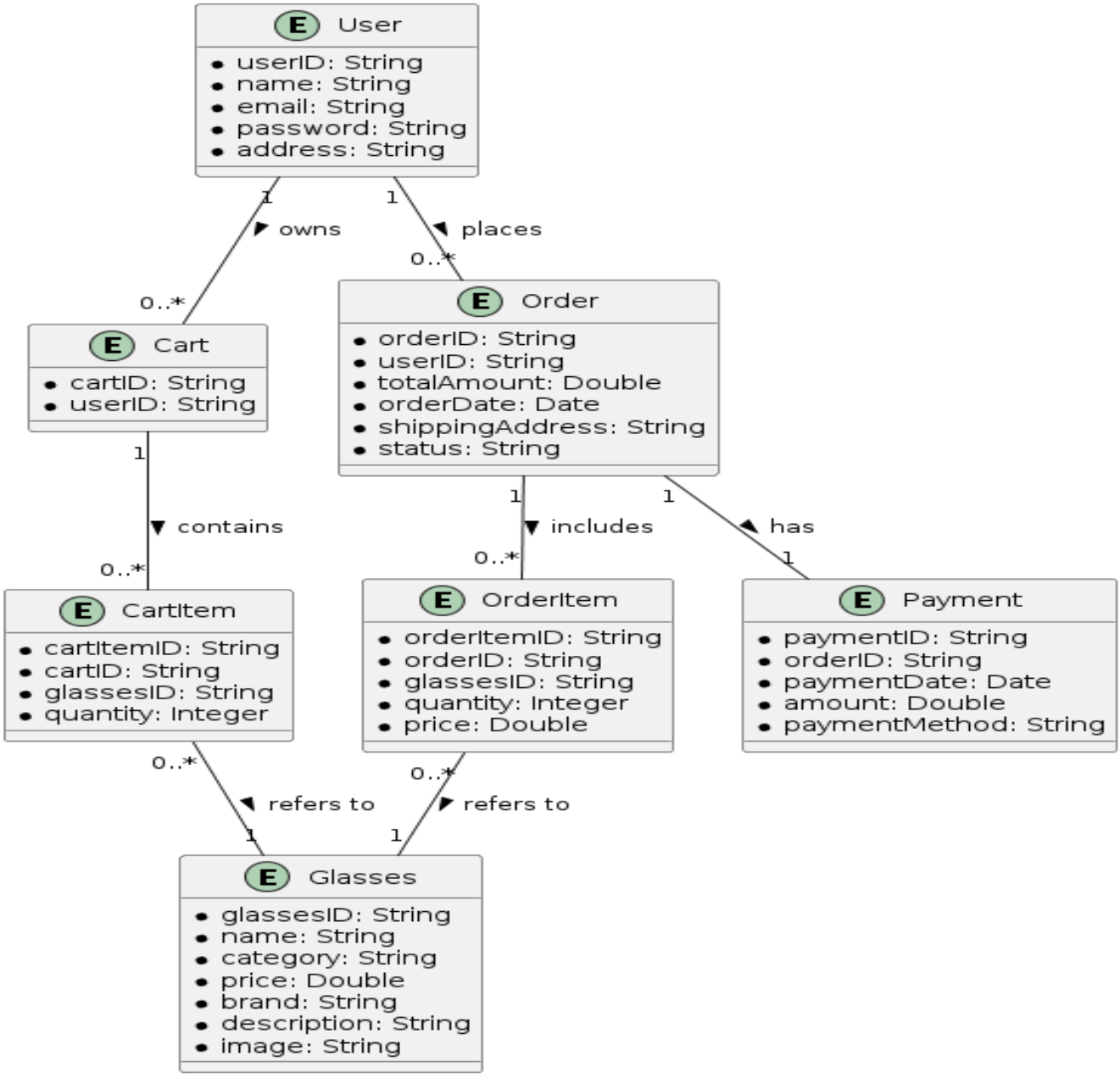

Figure 9 Entity Diagram of Chashmart

4.4. Class Diagram

The class diagram for the "Chashmart" app depicts the various classes and their relationships within the system. It includes essential entities and their attributes, along with methods representing functionalities. The diagram showcases how different classes interact with each other to facilitate the app's operations. Key classes include User, Admin, Glasses, Cart, Order, Category, Chat, AR Feature, Ai Suggestion, and Rating.

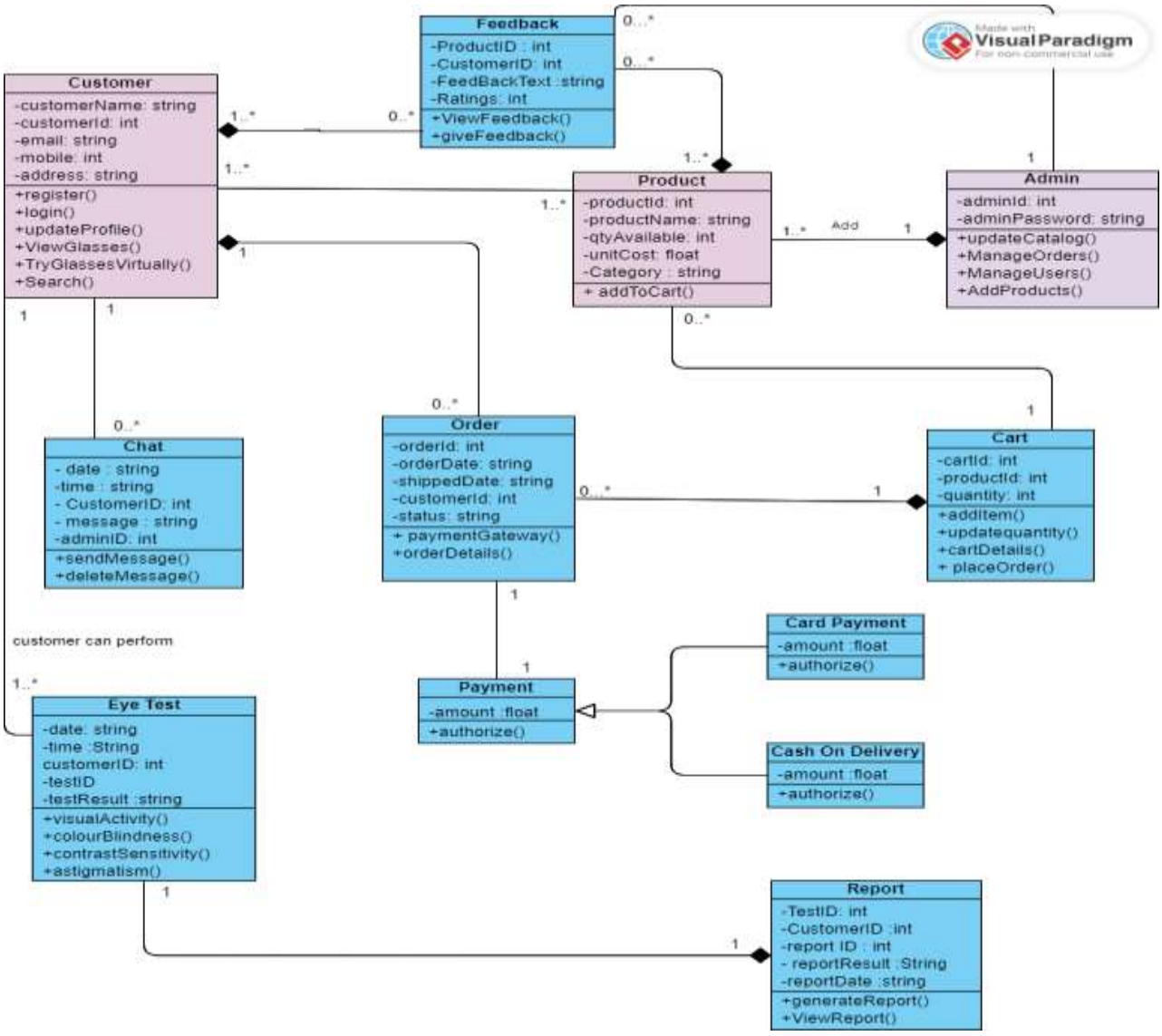

Figure 10 Class Diagram of Chashmart

4.5. Sequence / Collaboration Diagram

The sequence diagram depicts the interaction process of utilizing the chat feature within the application.

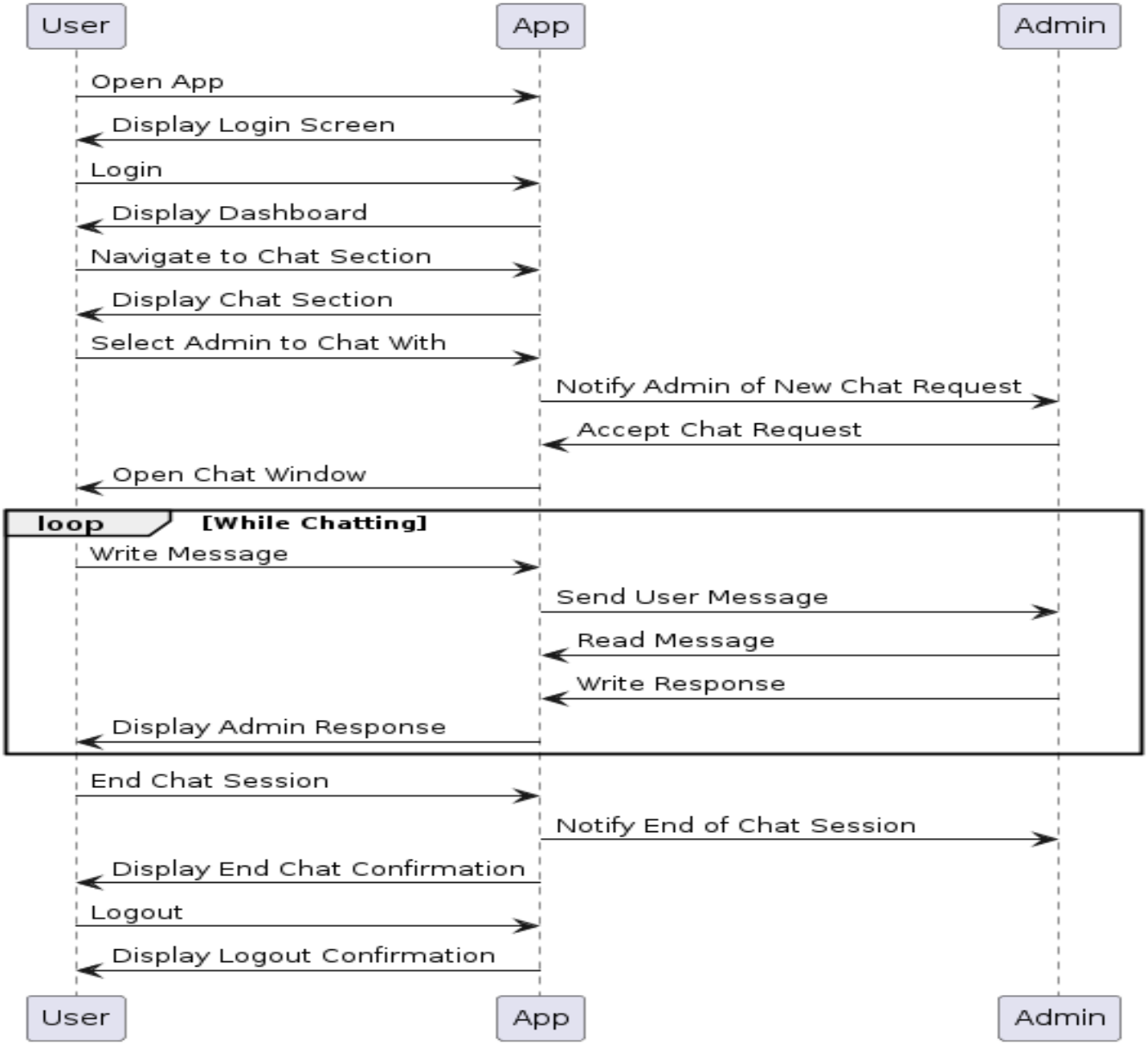

Figure 11 Sequence Diagram chat feature of Chashmart

The sequence diagram illustrates the user interaction flow with the Chashmart AR app for 3D try-on glasses, integrating AI to suggest personalized recommendations.

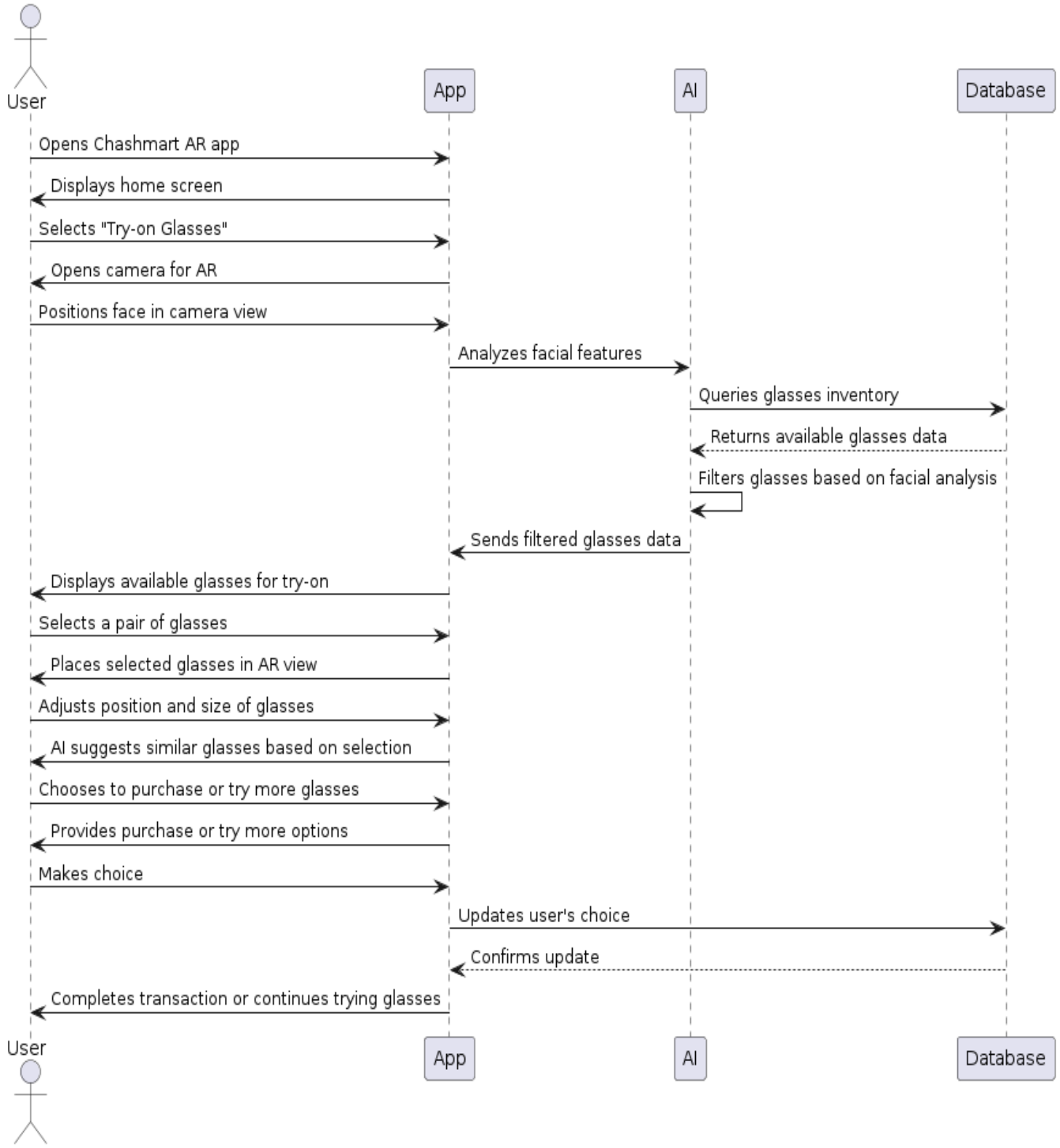

Figure 12 Sequence Diagram of Glasses Try on of Chashmart

4.6. Activity Diagram

The activity diagram demonstrates the sequential steps involved in utilizing the Chashmart.

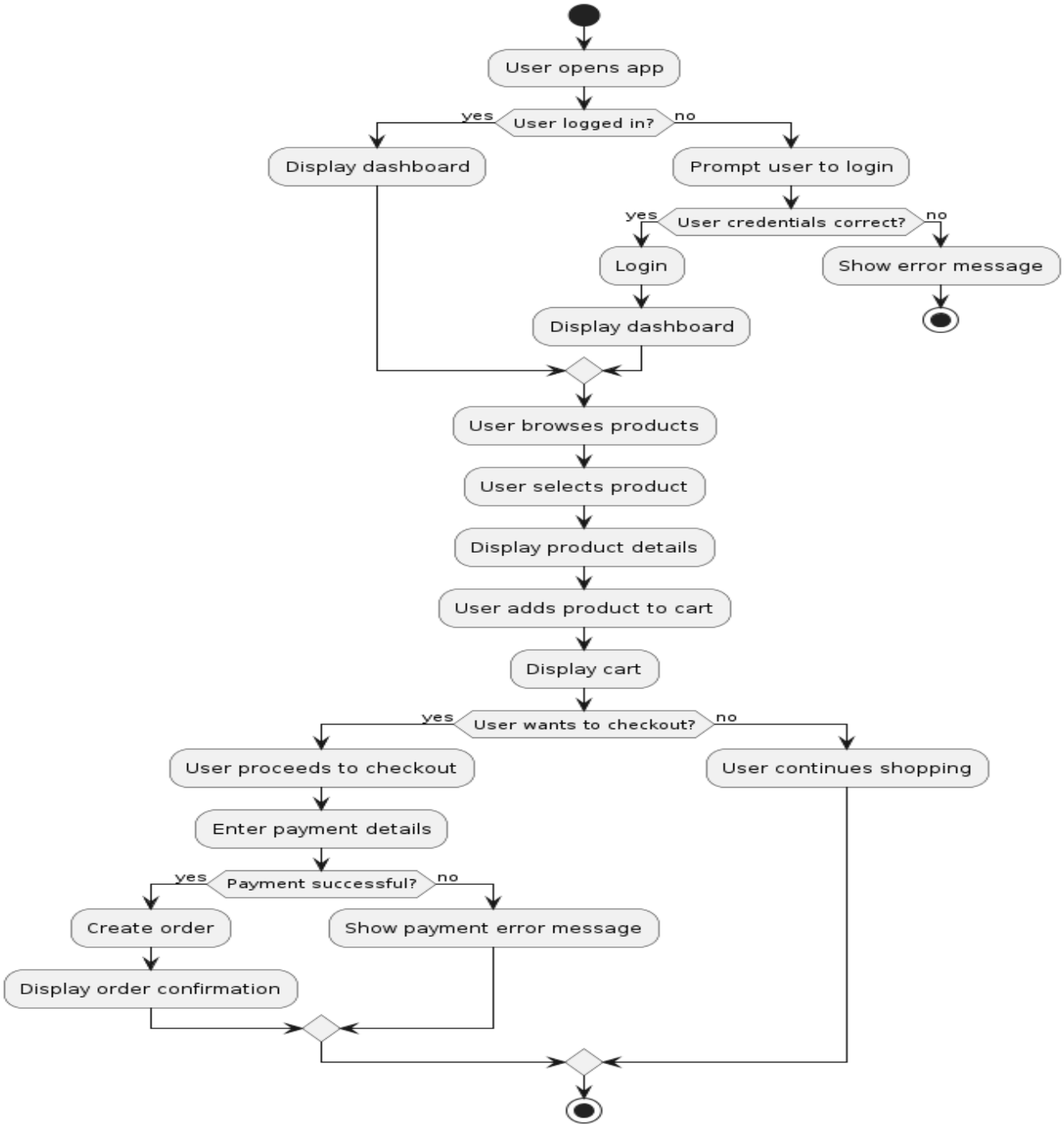

Figure 13 Activity Diagram of Chasmart

Chapter 5
Implementation

Chapter 5: Implementation

The Implementation chapter focuses on translating the design specifications into functioning software, encompassing various aspects such as flow control, selection of components and libraries, deployment environment setup, tools and techniques employed, adherence to coding standards, and version control.

5.1. Important Flow Control/Pseudo codes

The Implementation chapter focuses on translating the design specifications into functioning software, encompassing various aspects such as flow control, selection of components and libraries, deployment environment setup, tools and techniques employed, adherence to coding standards, and version control.

Table 46 Pseudo code 1 Face Land-Mark Detection of Chashmart

Pseudo code 1 Face Land-Mark Detection
Input: Video stream frames captured from a webcam or another video source.
Output: Real-time display of the video stream with detected faces and their corresponding landmarks (points such as eyes, nose, mouth, etc.) drawn on the frames.
1. Load the necessary libraries/modules: imutils, cv2 (OpenCV), dlib 2. Print loading message for facial landmark predictor 3. Load the facial landmark predictor from the provided file "shape_predictor_68_face_landmarks.dat" 4. Print camera warming up message 5. Start the video stream using Video Stream with index 0 (usually the default webcam) 6. Allow some time for the camera sensor to warm up 7. While True: # Infinite loop to continuously process frames 8. Read a frame from the video stream 9. Resize the frame to have a maximum height of 600 pixels 10. Convert the frame to grayscale for face detection 11. Detect faces in the grayscale frame using dlib's face detector 12. Loop over each detected face rectangle 13. Extract the bounding box coordinates (x, y, w, h) from the face rectangle 14. Draw a rectangle around the detected face on the original frame

15. Use the facial landmark predictor to predict landmarks on the face within the detected rectangle
16. Convert the predicted landmarks to NumPy array format
17. Loop over each landmark point
18. Draw a small circle at each landmark point on the original frame
19. Display the frame with detected faces and landmarks
20. Wait for a key press event with a timeout of 1 millisecond
21. If the 'q' key is pressed, break out of the loop
22. Cleanup:

Table 47 Pseudo code 2 Face shape classification using k-means clustering of Chashmart

Pseudo code 2 Face shape classification using k-means clustering
Input: Input image containing one or more faces.
Output: Visualized image with detected faces, facial landmarks, and determined face shape.
1 Import necessary libraries/modules: numpy, cv2, dlib, sklearn.cluster. 2 Specify paths for the image to be processed, the frontal face cascade classifier, and the facial landmark predictor file. 3 Load the image using OpenCV. 4 Convert the image to grayscale. 5 Detect faces in the grayscale image using the frontal face cascade classifier. 6 For each detected face: 7 Draw a rectangle around the face. 8 Use dlib's shape predictor to detect facial landmarks. 9 Visualize the detected facial landmarks by drawing circles and numbering them. 10 Perform KMeans clustering on the forehead region of the detected faces. 11 Analyze facial measurements such as jawline length, forehead width, and angle between specific facial landmarks. 12 Determine the shape of the face based on the analyzed measurements (e.g., squared, round, triangular, rectangular, or oblong). 13 Display the original image with detected faces, landmarks, and the determined face shape. 14 Wait for a key press to close the output window.

5.2. Components

User Interface and Database

1. The front-end component is responsible for rendering the web interface, including product listings, shopping cart, checkout process, and interactive elements for AI and AR functionalities.
2. Stores persistent data related to users, products, orders, and other system entities.

AI Engine

1. Utilized for personalized product recommendations based on user behavior, preferences, and historical data.

AR Module

2. Implements Augmented Reality features, allowing users to virtually try on glasses using their device's camera.

Eye Test Module

1. Provides basic eye test functionalities, guiding users through vision assessment and suggesting suitable eyewear products.

5.3. Libraries

1. Firebase_core for Firebase initialization in Flutter.
2. Use tflite_flutter to load a saved CNN model in Flutter.
3. Use kommunicate_flutter to integrate Kommunicate chat in Flutter.
4. Use firebase_auth for authentication, firebase_firestore_database for database, and firebase_storage for cloud storage.

5.4. Web Services

1. Utilize external web services Kommunicate for chat functionalities
2. Firebase for backend services including firestore database management, user authentication, and cloud storage.

5.5. Tools and Techniques

	Tools	Version	Rationale
Tools And Technologies	Android Studio/visual studio	2015	IDE
	Adobe XD/ Figma	CSC 6	Design Work
	Firebase	11.4.0	Back-end Development
	Flutter	3.7	Front-end Development
	Dart	0.23.1	SDK
	Git Hub	3.7.7	Source version control

Figure 14 Tools and Technology for Chashmart Project

Chapter 6
Business Plan

Chapter 6: Business Plan

A business plan is an in-depth road map that covers the goals, tactics, operations, and projected financials of a firm. It analyzes market trends and rivals and defines the distinctive value proposition, target market, and core concept. It also covers operating procedures, organizational structure, and marketing and sales tactics. Risk management techniques are also covered, along with financial projections that include income estimates and funding requirements. A business plan is essentially a detailed road map that helps entrepreneurs create and run a profitable company by elucidating objectives, tactics, and possible obstacles.

6.1 Business Description

Chashmart is an innovative mobile application designed to revolutionize the eyewear shopping experience. With focus on virtual try-on technology, personalized eye health awareness tools, chashmart aims to redefine how users engage with and select eyewear

6.1.1 Mission

1. Provide a convenient home-based solution for viewing, purchasing, and trying different glasses Act as a personal stylist through AI-driven recommendations based on user face shapes
2. Address challenges like reducing eye diseases, providing access to eye care products in remote locations, ensuring accurate prescriptions, and enabling customers to visualize glasses

6.1.2 Vision

1. Position ChashMart as a leading platform in the eyewear industry that seamlessly combines technology and eye health awareness

6.2 Market Analysis & Strategy

- In 2024, the Eyewear market in Pakistan is expected to generate a revenue of US$428.60m.
- It is predicted to grow annually by 3.58%
- The largest segment in this market is Spectacle Lenses, which is expected to have a market volume of US$185.90m by 2024.

- In terms of per person revenue, Pakistan is expected to generate US$1.75 in 2024.
- The volume in the Eyewear market is anticipated to reach 83.4m pieces by 2028.
- Additionally, the market is expected to show a volume growth of 5.9% in 2025.
- Moreover, by 2024, 97% of sales in the Eyewear market in Pakistan will be attributable to non-luxury.
- Pakistan's eyewear market is seeing a surge in demand for stylish, affordable glasses due to the growing middle class and increasing awareness about eye health.

6.2.1 Target Audience:

1. Tech-savvy individuals who prefer online shopping.
2. Customers looking for a personalized and convenient eyewear shopping experience.
3. Individuals in remote locations with limited access to eyewear products and eye-care services.

6.2.2 Industry Trends:

1. Growing reliance on technology in various industries.
2. Increased preference for online shopping and virtual experiences.
3. Rising awareness of eye health.

6.2.3 Marketing Strategies:

1. Social media campaigns targeting fashion and tech enthusiasts.
2. Collaborations with influencers for product endorsements.
3. SEO optimization for online visibility.
4. Digital marketing

6.2.4 Sales and Monetization Strategies:

1. App stores (Google Play, Apple App Store).
2. Direct online sales through the Chashmart Mobile Application.
3. Partnerships with eyewear retailers for expanded reach.

4. Establishing the brand and gaining user traction.
5. Increased user base and revenue from premium subscriptions.
6. Freemium model with basic features available for free.
7. Premium subscription for advanced features and exclusive benefits

6.3 Competitive Analysis

6.3.1 Competitors:

1. **Lens kart**: Established online eyewear retailer with a wide range of products and strong brand presence in the market in India.
2. **Punjab Optics:** Well-known eyewear brand with physical stores and online presence, offering a variety of eyewear products.
3. **Ray-Ban**: Global eyewear brand known for its premium quality and iconic designs, competing in the higher-end segment.

6.3.2 Differentiators:

1. Reduction of time spent searching for the perfect pair.
2. Integration of Al algorithms for accurate face shape classification.
3. Contribution to eye health awareness beyond a shopping platform.
4. Eye testing tools integration

6.4 Products/Services Description

6.4.1 Key Features:

1. Virtual try-on technology.
2. Al-driven personalized suggestions.
3. Eye health awareness tools, including a vision testing tool.
4. In App Purchase and Payment
5. Customer Support Service

6.5 SWOT Analysis

6.5.1 Strengths:

1. Innovative mobile application with virtual try-on technology, offering a unique shopping experience.
2. AI-driven personalized suggestions and eye health awareness tools, adding value beyond traditional eyewear retail.
3. Focus on convenience and accessibility, particularly for individuals in remote locations.
4. Integration of eye testing tools, addressing a crucial aspect of eye health.

6.5.2 Weaknesses:

1. Dependency on technology, with potential operational risks such as technical glitches affecting user experience.
2. Relatively new in the market, lacking established brand recognition compared to competitors.
3. Limited reach and customer base initially, needing to invest in marketing and user acquisition.

6.5.3 Opportunities:

1. Growing eyewear market in Pakistan with increasing demand for stylish and affordable glasses.
2. Rising preference for online shopping and virtual experiences, aligning with Chashmart's offerings.
3. Potential for partnerships with eyewear retailers to expand reach and distribution channels.

6.5.4 Threats

1. Changing consumer preferences and market dynamics may pose challenges in maintaining relevance.
2. Competition from established eyewear brands like Lenskart and Punjab Optics, which have strong brand recognition and market presence.
3. Technical risks such as internet connectivity issues affecting user experience and app performance.

Chapter 7

Testing & Evaluation

Chapter 7: Testing and Evaluation

The Testing and Evaluation chapter focuses on ensuring the quality, reliability, and performance of the developed software through rigorous testing methodologies. It involves verifying that the software meets the specified requirements, identifying and rectifying defects, and evaluating its overall effectiveness.

Use Case Testing (Test Cases)

7.1 Unit Testing

Table 48 Unit Testing of Chashmart

No	Test case/Test script	Attribute and value	Expected result	Result
1.	Sign up Page: Incorrect email entry	Email: abc.domain.com	Highlights field and displays error message	Pass
2.	Sign up Page: Password character limit	Password: 12345	Password should not be accepted and display an error message	Pass
3.	Login Page: Successful Login	Email: Raha@gmail.com Password: 12345	If email and password match, login to dashboard page	Pass
4.	Profile Page: Display user info	Name: Raha Ali Email: raha@gmail.com	Displays user's name and email on top of the profile page	Pass
5.	Profile Page: Edit profile name	New Name: Raha Malik	Allows updating of the name field	Pass
6.	Contact Us Page: Submit message	Message: "I have an issue with my order."	Message submitted successfully	Pass
7.	Glasses Details: Add glasses to cart	Select glasses and add to cart	Glasses added to the cart successfully	Pass
8.	Add to Cart Page: Delete item	Click on Delete button	Item is removed from the cart	Pass

9.	Add to Favorites: Add item	Select a item and add to favorites	Item is added to favorites	Pass
10.	Rate This App: Submit rating	Rating: 4 stars Review: "Great app!"	Rating submitted successfully with review	Pass
11.	Checkout Process	Proceed to checkout from the cart	User redirected to the checkout page.	Pass
12.	Logout	Click on logout button	Users should be logged out and redirected to the Splash Screen.	Pass
13.	Virtual Try On	Select any eyeglasses inside try on section.	The eyeglasses should be superimposed on user's face in real time.	Pass
14.	Eye Test	Select any eye test	The user should be able to perform eye tests and view results.	Pass
15	Add Product Admin	Fill product details	The product should be added.	Pass
16	User Forgot Password	Provide your registered mail	The password recovery instructions should be sent to the user's registered mail.	Pass

7.2 Functional Testing

Table 49 Functional Testing for Chashmart

No	Test case/Test script	Attribute and value	Expected result	Actual Result	Pass
1	Invalid Email Format	Email: abc@domain.com	Display error message indicating invalid email format.	Error message displayed: "Invalid email format."	Pass
2	Login Functionality	Email: abc@gmail.com, Password: 123456	Users should be redirected to the dashboard page after successful login.	User is redirected to the dashboard page.	Pass
3	Login Error Handling	Email: abc@domain.com Password: 12	Display error message indicating incorrect email or password.	Error message displayed: "Incorrect email or password."	Pass
4	Profile Update Functionality	New Name: Raha Malik	User's name should be updated to Raha Malik.	User's name updated successfully to Raha Malik.	Pass
5	Add Item to Cart	Select an item and click "Add to Cart"	Item should be added to the cart.	Item added to the cart successfully.	Pass
6	Remove Items from Cart	Click "Remove"	Items should be removed from the cart.	Items removed from the cart successfully.	Pass
7	Add Item to Favorites	Select an item and click "Add to Favorites"	Item should be added to favorites.	Item added to favorites successfully.	Pass

8	Rate the App	Rating: 4 stars, Review: "Great app!"	Rating and review should be submitted successfully.	Rating and review submitted successfully.	Pass
9	Contact Us Functionality	Message: "I have an issue with my order."	Message should be submitted successfully.	Message submitted successfully.	Pass
10	View Glasses in Dashboard	Select various sections (e.g., round glasses, square glasses)	Users should be able to view glasses in the selected section.	Users can view glasses in the selected sections.	Pass
11	Add Item to Favorites	Select another item and click "Add to Favorites"	Another item should be added to my favorites.	Another item added to favorites successfully.	Pass
12	Logout Functionality	Click on logout button	Users should be logged out and redirected to the login page.	User logged out and redirected to the Splash Screen	Pass
13	Tryon Functionality	Select any glasses inside Tryon section	The glasses should be superimposed on the user's face in real time.	The glasses were superimposed in real time.	Pass
14	Eye Test	Select any Eye Test	The user should be able to perform eye tests and view result.	The test was performed, and result was shown.	Pass
15	Admin Add Products	Fill Product Details	The product should be added successfully.	The product was added successfully.	Pass

16	User Forgot Password	Provide your registered mail	The password recovery instructions should be sent to the user's registered mail.	The instructions were sent to the user and password was recovered successfully.	Pass

7.3 Business Rule Testing:

Table 50 Business Rule Testing for Chasmart

Test Case	Conditions	Expected Actions
1.	Unique email requirement	Attempt to sign up with an email address that is already registered
2.	Password length must be greater than 6	Attempt to sign up with a password above than 6 characters
3.	Username already exists	Attempt to sign up with a username that already exists
4.	Invalid email format	Attempt to sign up with an email address in an invalid format

7.4 Integration Testing:

Table 51 Integration Testing of Chashmart

No.	Test Case/Test Script	Attribute and Value	Expected Result	Actual Result
1.	Login Functionality and Profile Update Integration	Username: Raha Ali Password:12345, New Name: Raha Malik	Successfully login and update profile information	User logged in successfully, and profile information updated successfully
2.	Add Item to Cart and Remove Items Integration	Item selected: Sunglasses code 1234	Add an item to the cart and then remove it	Item added to the cart successfully and then removed successfully
3.	Contact Us Functionality and View Glasses Integration	Message: "I have an issue with my order."	Submit a message and then view glasses in the dashboard	Message submitted successfully and able to view glasses
4.	Rate the App and Logout Integration	Rating: 4 stars, Review: "Great app!"	Rate the app and then logout	Rating submitted successfully and able to logout
5.	View Cart and Proceed to Buy	Click on "Proceed to Buy" button	User should be directed to the checkout process	User redirected to the checkout process
6.	Admin Adding a product	Fill details and click add product button	The product should be added to firebase	The product was added and was showing in user app
7.	Forgot Password user	Email:test@fawadhussain@gmail.com	The email should be sent to the user.	The email was received.

Chapter 8

Conclusion & Future Enhancements

Chapter 8: Conclusion & Future Enhancements

8.1 Achievements and Improvement

Talking about achievements first: to be honest as students we want to do some project which brings some innovation into the market, and we were motivated to do so. In our fifth semester we had an idea that we had pitched, and we got positive feedback we know the idea is great, but we want to make sure that we do it as best as we can because your FYP is the most important part of your degree, so we were fully focused. Now we had to choose the stack like we wanted it to be a website or a mobile application. Luckily, we were already doing freelancing in flutter, and we know its potential being a cross-platform development platform and that's exactly what make things a little easy for us because we already knew the development stack. Then we divided our tasks into 3 parts as one major module was to be done by each person with other small modules. The development started and we achieved good results as we were able to build our mobile application within the sixth semester but still our two main modules of AI and AR were left. Next our focus was on that here come few challenges first challenge was accuracy of AI model and second was the issue of AR packages in flutter. The AI part was still in progress but for AR we had to try different things like Unity, ARCORE flutter, DEEPAR after trying all it was frustrating but finally there was google ml vision which worked.

Well, it worked but still I think there is need of improvement because the google ml vision detect facial landmark in real time and place eyeglasses on top of those specific landmarks so it is a bit slow and as developers, we know that but considering that it was a big achievement as well because we know how difficult it can be to implement AR like technologies in mobile app. The accuracy of virtual try-on is still great but is slow due to mobile constraints. Now there was another important module of eye testing as well for that we did a lot of research that how we can incorporate those real-world eye examinations in a mobile application. We studied many research papers like what ideal distance should be when we read Snellen chart from mobile also, we did research on other eye tests Aswell. Well, that module is still well implemented with an option of almost 10 eye exams with visual acuity test still at basic level. Our model also achieved good accuracy and was integrated with the mobile app successfully. Overall, the experience was great and full of learning.

8.2 Critical Review

While Chashmart has shown promise, it's essential to acknowledge areas for improvement. Feedback from testing phases has highlighted occasional inaccuracies in the virtual try-on feature and the need for a more extensive eyewear collection to cater to diverse tastes. Additionally, further refinement of the eye test functionality is necessary to ensure its reliability and effectiveness. Addressing these issues will be crucial as we prepare for the platform's launch.

8.3 Lessons Learnt

Well, the journey was good, but we learnt a few lessons which we are going to share:

- Always start your project in a tech stack which is easy to implement in it like we choose flutter, and it had many issues which were frustrating like you choose an old package your project will not build, and packages don’t update on regular basis, so we had limited options.
- Select the stack which is most suitable and easy for your project to build.

8.4 Future Enhancements/Recommendations

Looking ahead, there are several areas where Chashmart can be further enhanced to better serve our users.

- Expanding the virtual try-on feature to include advanced customization options, such as lens types and coatings, will provide users with a more personalized shopping experience.
- More accurate eye tests so the user can trust our platform.

Furthermore, we plan to explore partnerships with optometry professionals to offer advanced eye testing services and teleconsultations, thereby promoting eye health awareness among our users.

Appendices

Appendix A: Information / Promotional Material

A.1. Broacher

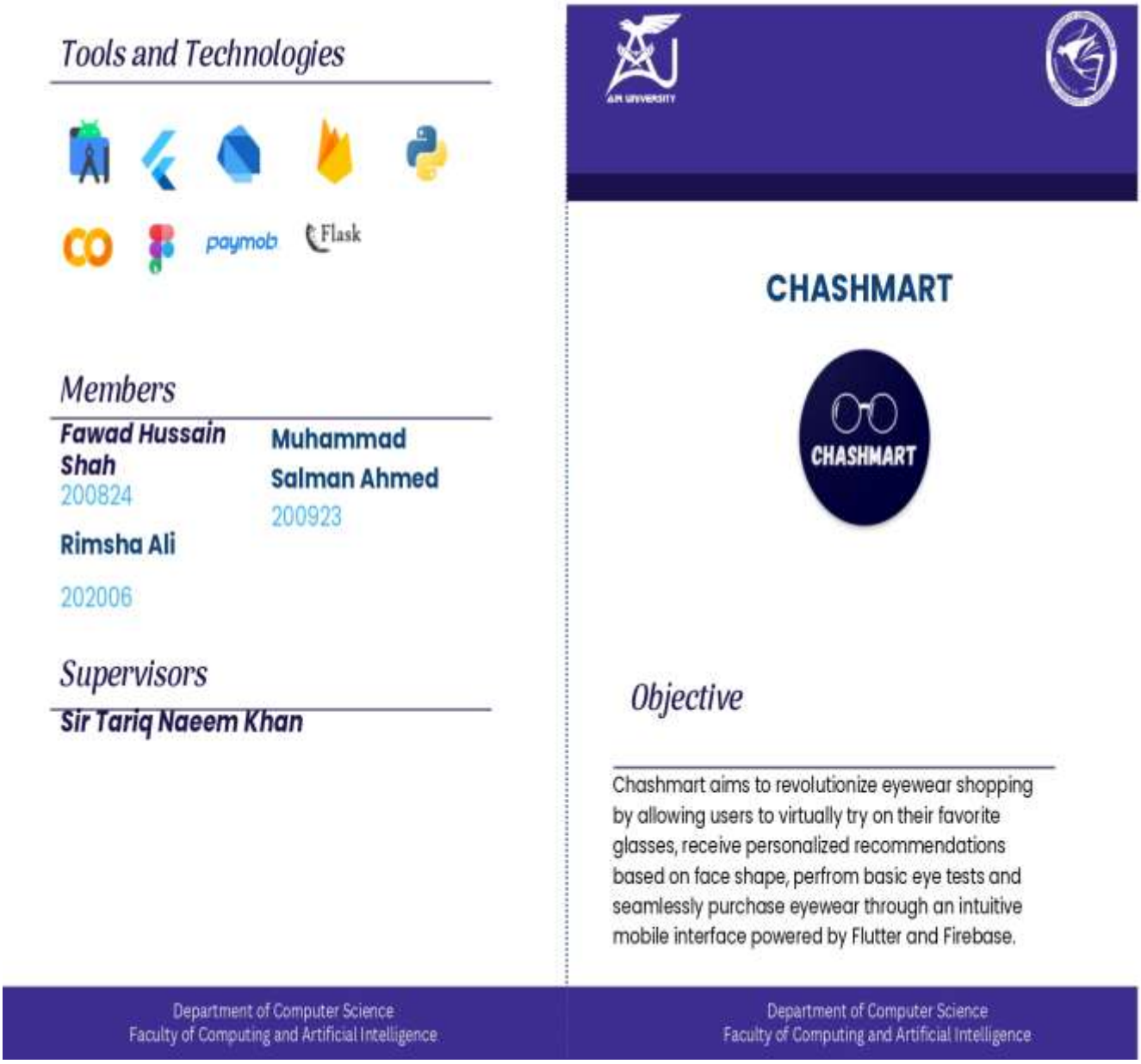

Figure 15 Chashmart Broacher

A.2. Standee

Figure 16 Chashmart Standee

References

[1]. Zhang, Boping. “Augmented Reality Virtual Glasses Try-on Technology Based on IOS Platform.”

Available: https://doi.org/10.1186/s13640-018-0373-8.

EURASIP Journal on Image and Video Processing, vol. 2018, no. 1, 27 Nov. 2018,

[2]. Getting started with AR Foundation. (n.d.). Google for Developers.

Available: https://developers.google.com/ar/develop/unity-arf/getting-started-ar-foundation

(Getting Started With AR Foundation, n.d. May 11, 2023 [May 12, 2023])

i.

[3]. “Machine Learning in Flutter”

Available: https://flutterdevs.com/blog/machine-learning-in-flutter

OCTOBER 12, 2020 [March 7,2023]

[4]. RT-BENE: A Dataset and Baselines for Real-Time Blink Estimation in Natural Environments.

Available: https://doi.org/10.1109/iccvw.2019.00147

Cortacero, K., Fischer, T., & Demiris, Y. (2019).