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Panda Mall

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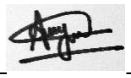
Signature: 

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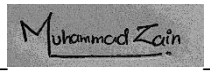
Signature: 

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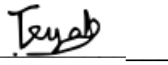
Signature: 

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Abstract

Pakistan's eCommerce market grew by 35-45% in 2021, contributing to a global growth rate of 29% [6]. Panda Mall is a web-based Recommendation System (RS) which recommends products from various online shopping stores in Pakistan based on customer preferences. It aims to solve the problem of choice overload [1] created as a result of hundreds of online shopping stores opening to cash in Pakistan's eCommerce boom and to combat the lockdowns imposed in the wake of Covid-19 pandemic. The main idea is to register products available from these online shopping stores using automated scrapping and manual registration in the system and recommend to registered customers based on preferences, feedback and history. Instead of visiting multiple websites and hundreds of products, a customer can sign up and let Panda Mall do all the browsing and filtering to display a manageable number of products in a modern and elegant interface. The website developed in this project use MySQL for the data storage, Python Django for backend business layer and machine learning algorithms implementation, React.JS for the front end. The fundamental idea is to enhance online shopping experience similar to how physical shopping malls enhanced the shopping experience for retail stores.

Chapter 1: Introduction

During the COVID-19 pandemic online apparel shopping stores, in Pakistan, have grown exponentially in number. One major challenge for customers is that at any given time there are hundreds of stores to buy from, which makes shopping a tedious task. With advancement in machine learning and data science, an obvious solution is a recommendation system which assist the buyers in decision making, similar to how Netflix [5] provides a recommendation system for its subscribers to choose the best movies.

The goal of this project is to develop an automated system that can scrape and collect data on clothing products, then optimize and analyze it using Artificial Intelligence and Data Science to make recommendations based on user preferences and purchase history.
Our primary focus will be on gathering data by registration or automatic scraping, processing the data, and displaying the recommendations in a user-friendly online interface. We will also keep track of each user's previous purchases in order to improve over time.

Data about brands and products will be obtained from:

i. Websites of brands directly.
ii. Registration at Panda Mall

The results obtained from the model will be presented in a simplified web interface along with all the necessary information for customers to make a buying decision with ease.

This document primarily covers how the system works and the concepts that were employed in its development. The work done in this scope is explained in the following chapter. Furthermore, in Chapter 3, all of our system's requirements, both functional and non-functional are described, as well as the system architecture, strategies and use cases. Chapter 4 covers the implementation and operation of our system. Finally, chapter 5 explains the overview, the obstacles that were encountered, and the breakdown of future work.

1.1 Goals and Objectives

The primary goals and objectives of this project are:

- To design a user-friendly website that helps in recommending the best clothing products for the user.
- To provide a platform where items of multiple stores will be listed for recommendation.
- To use Machine Learning (ML) models such as collaborative filtering to produce efficient and effective recommendation engine.

1.2 Scope of the Project

The project will be implemented in three components. In first component, brands and product data will be collected from both automated web scrappers and a manual store registration process at Panda Mall website. After data analysis, it will be exported to the second component. Second component will use this data to train a machine learning model using a custom-built variation of collaborative filtering algorithm.
Third component will consist of creating a website module for the users. User can register on the website. With the account user can search a product of their interest. The items can be filtered with the various options size, color and preferred brand etc. Items displayed on the result query will filter through the options before it is fed as input to the model trained in component two, the output will contain a filtered list of the best recommended products for the particular user. After the purchase of product, users will be reminded to fill out the feedback against the purchase. This feedback will be permanently recorded for future recommendations.

The Scope of project doesn’t include a payment gateway or a shopping a cart. However, as a point of future scope adding a shopping cart with payment and logistics could be a potential work to extend the scope of this project.

Chapter 2: Literature Survey / Related Work

2.1 Functional Tensor Factorization

Hu et al. [2] researched on personalized clothing recommendation systems. He presented a functional tensor factorization approach to describe user-item and item-item interaction.

2.2 Collaborative Filtering

Nogueira et al. [3] proposed a new collaborative filtering algorithm for better accuracy in clothing recommendation systems. After a lot of research, we have inclined towards collaborative filtering method for our recommendation system as we have found it more effective and accurate in these types of recommendation systems. Landia in [4] explains challenges faced during construction of fashion recommendation system. He has organized challenges into two categories namely retailer related and customer related. The prior consists of short lifetime of items and high volume of items, whereas seasonality and rapidly changing customer preferences make up some of the customer related challenges. Majority of the recommendation systems deal with products from a single clothing store unlike our system which will deal with different type of clothes from different clothing stores.

Chapter 3: Requirements and Design

3.1 Functional Requirements

3.1.1 Functional requirements for Users

- The System will allow user to login by authenticating user login credentials.
- Users will be able to create a new account by entering the required information into the system.
- The System will allow user to reset password via email.
- The System will allow user to logout.
- The System will allow user to edit profile.
- The System will display clothing products based on user's profile.
- The system will enable the user to filter products based on their type.
- The system will enable the user to filter products based on their sizes.
- The system will enable the user to filter products based on their colours.
- The system will enable the user to filter products based on their waist.
- The system will enable the user to filter products based on their price range.
- The system will enable the user to filter products based on their discount factor.
- The system will enable the user to filter products based on their brands.
- The System will allow user to view selected product details.
- The System will allow user to buy product by redirecting to respected page.
- The System will allow user to add products to favourites.
- The System will allow user to give feedback on the product bought.

3.1.2 Functional requirements for Administrators

- Administrators can approve/reject products.
- Administrators can update products.
- Administrators can view products.

3.1.3 Functional requirements for Stores

- Stores can add products.
- Stores can update products.
- Stores can view products.
- Stores can remove products.

3.2 Non-Functional Requirements

3.2.1 Availability

System will be available for the users for at-least 160 hours a week.

3.2.2 Usability

System will have an intuitive design.

- Our system interface will be easy to learn and user interactive. A rookie will require at-most 5 seconds to learn the interface.

3.2.3 Reliability

System will show the result of the desired filter within 3 seconds.

3.2.4 Scalability

System will ensure there will be no significant performance degrade for at-most 100 users.

3.2.5 Data Integrity

System will ensure user's personal data is not tempered by unauthorized source.

3.2.6 Performance

All data views are paginated to allow limited and required information to prevent long load times.

3.3 Hardware and Software Requirements

3.3.1 Hardware Requirement

- A IOT device that supports a browser.
- Internet connection should have at least 1Mbps.
- A web server to host our website.

3.3.2 Software Requirement

Web browser in the system.

3.4 System Architecture

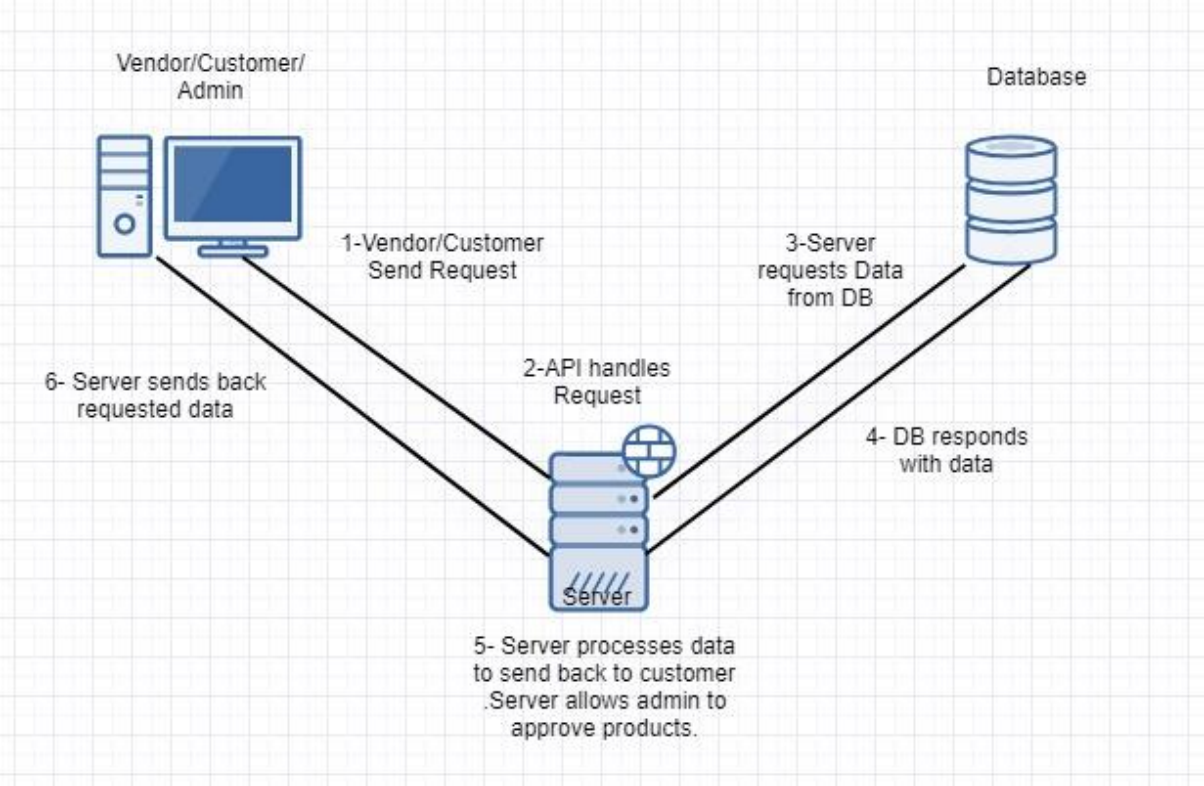

Figure 1: High Level System Architecture
This is System Architecture Diagram for our system.

As show in the diagram above we will be using 3-layer architecture for our system. Our users (Customer, Vendor and Admin) will interact with the presentation layer that will forward user requests to the server which will be acting as the business layer. It will process all the user request and send them back to the presentation layer. If needed it will interact with our cloud-based database that corresponds to the database layer to retrieve any kind of information needed.

3.4.1 Front-end

Our front-end has the following components:

3.4.1.1 Customer

Customer is the user that logs in to our system using his account and interacts with the application to buy products. Each customer request goes from the presentation layer to the server where the request is processed and the required data is fetched from the database layer and then the result in forwarded back to the presentation layer where the results are shown to the customer. Customer can perform following requests/functions:

- Login
- Sign up
- Reset password
- Logout
- Edit Profile

- Buy product
- Add products to favourites
- Give feedback on products
- Filter products based on several filters

3.4.1.2 Vendor

Vendor is the user which creates a store and then adds his/her products to our website. Each vendor request goes from the presentation layer to the server where the request is processed and the given data is stored to the database layer. Vendor can perform following requests/functions

- Add products
- Update products
- View products
- Remove products

3.4.1.3 Admin

Admin is the user of the system which approves the newly added products. If he approved a product then the product is added to the database otherwise the product is discarded.

- Approve/Reject products
- View products

3.4.2 Back-end

Our Back-end has the following components:

3.4.2.1 Express Server

Our server connects our database layer to the presentation layer. It processes all the requests coming from the users (presentation layer) in HTML format. After processing the request, it fetches the required information from the database layer in the form of JSON objects. After that the server responds back to the presentation layer by sending the requested information.

3.4.2.2 MySQL

This is our database where all the information about system users, products is stored in relational format. Our database is hosted on the cloud so as a result it is scalable and efficient. It assists our server by providing required information needed to respond to user requests.

3.4.3 Subsystem Architecture

There is no such component in our system architecture section that merits a detailed discussion

3.5 Architectural Strategies

3.5.1 ReactJS, Node JS, Python, Django, MySQL

When it comes to machine learning there is no better option than Python. As it provides different types of libraries to manipulate and perform different functions on large amount of data. We will be using python with Jupiter Notebook.
Our system's front end will be designed using ReactJS. It provides us with JavaScript libraries that helps us to perform our work. Major benefit of using ReactJS is its reusable components that allows us to use same components for different pages wherever needed. Furthermore, ReactJS allows for large data changes to be automatically reflected in chosen areas of user interfaces.
We will be using Django with python as our backend languages. Every other aspect expects for manipulating datasets will be handled by Python.
For our server we have decided to use Express Server. As we are using JavaScript for our frontend and backend so why not using it to implement the server. Major benefit of using this server is its ability to handle several requests efficiently. Moreover, it also has a highly supportive open-source community.
For our database we will be using MySQL because of its scalability benefits. It has a very simple design with all the data stored as a relational object hence making key functions like saving and loading data relatively easier.

3.5.2 Future plans for enhancing software

For this project we are limiting our scope to a web application but in the future, we are planning to scale our project by:

- We are planning to implement a cart system that we will integrate with the payment procedure to help our users to buy product directly from our website.

- We plan to develop a mobile application with all the features of our web application in order to assist the user.

3.5.3 User interface paradigms

While making our UI we will implement the eight golden rules of user interaction in our Software Engineering course. Following are those rules:

1. Make an effort to be consistent.
2. Strive for universal applicability.
3. Provide useful feedback.
4. Design dialogs.
5. Prevent errors.
6. Allow for easy action reversal.
7. Allow users to maintain control.
8. Reduce the amount of data stored in short-term memory.

This will help our UI to be able to yield better performance and efficiency. It will also make our UI user friendly.

3.5.4 Error detection and recovery

In our situation, the most typical error occurs during the authentication process, when a user enters incorrect credentials, which our system authenticates and, if they are invalid, displays an error message to the user.
Furthermore, if a user inputs incorrect information during registration or profile modification, our system will display an error message requiring the user to reenter the incorrect information. If a user attempts to purchase a product that the vendor has rendered unavailable, our system display popup menu to let them know of the product's unavailability. Furthermore, we will update the product list once a week to ensure that users have access to the most up-to-date products.

3.5.5 Concurrency and Synchronization

Hopefully a lot of users will be accessing our website and as result making lot of simultaneous requests. So, we need to make our system synchronized so that we can treat each request independently. In order to do that we have to implement threading into our business logic. Moreover, with multithreading in place we will have to ensure synchronization of the entire system for users to avoid unexpected behaviors in the system.

3.6 Use Cases

3.6.1 Login Account

Name	Login Account		
Actors	Client, Admin, Store Owner		
Summary	User will be able to login into account.		
Pre-Conditions	User should be registered in the system. User should not already be logged in.		
Post-Conditions	User shall be logged in successfully.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User opens the login page.	2	System displays Login page asking for username and password.
3	User enters valid login credentials and press login button.	4	System verifies the user credentials, establishes session and redirects the user to the home page.
Alternative Flow			
Actor Action		**System Response**	
3	User enters invalid login credentials and presses the login button.	4-A	System prompts the error message: *Incorrect username or password entered.*

3.6.2 Create Account

Name	Create Account		
Actors	Client		
Summary	User will be able to create a new account by providing the required information.		
Pre-Conditions	User clicked on Sign-up button from the login page.		
Post-Conditions	User's account shall be created successfully.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the Sign-up button from the Login page.	2	System displays Sign-up page asking for required information.
3	User enters valid information and presses submit button.	4	The system verifies the data, creates a new account for the user, and brings them to the login page.
Alternative Flow			
Actor Action		**System Response**	
3	User enters invalid information and presses submit button.	4-A	System prompts the error message: *Incorrect/Missing required information*

3.6.3 Reset Password

Name	Reset Password
Actors	Client
Summary	User will be able to reset his/her account password.
Pre-Conditions	User should have an existing account. User clicked on “Forget Password?” button from Login page.
Post-Conditions	User shall receive reset password request on his/her email.
Special Requirements	None

Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Forget Password?” button from the Login page.	2	System displays a prompt asking for user’s username.
3	User enters username and presses submit button.	4	System verifies the username, sends an email to the respective user account and redirects the user to the login page.

Alternative Flow			
Actor Action		**System Response**	
3	User enters invalid username and presses submit button.	4-A	System prompts the error message: *Username not found*

3.6.4 Logout

Name	Logout
Actors	Client
Summary	User will be able to logout his/her account.
Pre-Conditions	User should have logged in. User clicked on “Logout” button from Home page.
Post-Conditions	User shall be logged out.
Special Requirements	None

Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Logout?” button from the home page.	2	System will logout the user and redirect the user to Login page.

No Alternative Flow

3.6.5 Edit Profile

Name	Edit Profile		
Actors	Client		
Summary	User will be able to edit his/her profile.		
Pre-Conditions	User should have logged in. User clicked on “Edit Profile” button from Home page.		
Post-Conditions	User’s profile shall be updated.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Edit Profile” button from the Home page.	2	System displays a new page containing user’s current information.
3	User edits his/her profile by providing valid information and presses update button.	4	System validates the information, updates his/her profile and redirects the user to the Home page.
Alternative Flow			
Actor Action		**System Response**	
3	User enters invalid profile information and presses update button.	4-A	System prompts the error message: *Information provided is incorrect.*

3.6.6 View Product Details

Name	View Product Details		
Actors	Client		
Summary	User will be able to view the details of the selected product.		
Pre-Conditions	User should have logged in. User should have clicked on a “Details” button.		
Post-Conditions	Users shall be to see the product details.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Details” button from the Home page.	2	System displays a pop-up containing product details.
No Alternative Flow			

3.6.7 Buy Product

Name	Buy a Product		
Actors	Client		
Summary	User will be able to buy a product from the respected brand's website.		
Pre-Conditions	User must be logged in. User must have clicked on "Detail" button for the selected product.		
Post-Conditions	System will redirect user to the respective brand website.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the "Buy" button located in the product details.	2	System redirects the user to the respected link of the product.
No Alternative Flow			

3.7

3.7.1 Add to Favorites

Name	Add to favorites		
Actors	Client		
Summary	User will be able to add a product to his/her favorites list.		
Pre-Conditions	User must be logged in. Selected product should not be in the favorites list		
Post-Conditions	System will update the favorites list by adding a product.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the "Favorites" icon from the selected product.	2	System adds the product to his/her favorites list.
No Alternative Flow			

3.7.2 Remove from favorites

Name	Remove from favorites		
Actors	Client		
Summary	User will be able to remove a product from his/her favorites list.		
Pre-Conditions	User must be logged in. Selected product should be in the favorites list		
Post-Conditions	System will update the favorites list by removing a product.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Favorites” icon from the selected product.	2	System will remove the product from his/her favorites list.
No Alternative Flow			

3.7.3 View favorites list

Name	View favorites list		
Actors	Client		
Summary	User will be able to view favorites list.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User shall be able to view his/her favorites list.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “View favorites” button from the home page.	2	System redirects the user to the new page containing a list of user’s favorite items. If there are no products in the favorites list then an empty list will be displayed.
No Alternative Flow			

3.7.4 Filter Product by Type

Name	Filter product by type		
Actors	Client		
Summary	User will be able to filter out products based on product type.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Type” filter from the dropdown menu.	4	System displays a pop-up of types for clothing products e.g. (Men’s T-Shirts, Men’s Polo Shirts, Men’s Trousers).
5	User selects a type from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.5 Filter Product by Size

Name	Filter product by size		
Actors	Client		
Summary	User will be able to filter out products based on product sizes.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Size” filter from the dropdown menu.	4	System displays a pop-up of sizes for clothing products e.g. (Small, Large).
5	User selects a size from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.6 Filter Product by Color

Name	Filter product by color		
Actors	Client		
Summary	User will be able to filter out products based on product color.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Color” filter from the dropdown menu.	4	System displays a pop-up of colors for clothing products e.g. (Red, Green).
5	User selects a color from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.7 Filter Product by Waist

Name	Filter product by waist		
Actors	Client		
Summary	User will be able to filter out products based on product waist.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Waist” filter from the dropdown menu.	4	System displays a pop-up of waists for clothing products e.g. (30-inch, 32-inch).
5	User selects a waist from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.8 Filter Product by Price Range

Name	Filter product by price range.		
Actors	Client		
Summary	User will be able to filter out products based on product price range.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Price” filter from the dropdown menu.	4	System displays a pop-up of price range for clothing products e.g. (Rs. 1200-1800, Rs. 750-1000).
5	User selects a price range from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.9 Filter Product by Discount Factor

Name	Filter product by discount factor		
Actors	Client		
Summary	User will be able to filter out products based on product discount factor.		
Pre-Conditions	User must be logged in.		
Post-Conditions	User will be able to view filtered product list.		
Special Requirements	Reliability (filtering takes less than 3 seconds).		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the “Filter” button from the home page.	2	System displays a dropdown menu containing different types of filters.
3	User selects the “Discounted” filter from the dropdown menu.	4	System displays a pop-up of Discount range for clothing products e.g. (20% - 30% off).
5	User selects a Discount range from the pop-up window.	6	System reloads the home page and displays the products based on the user’s filtering criteria.
No Alternative Flow			

3.7.10 Approve Products

Name	Approve product
Actors	Admin
Summary	Admin will be able to see the details of a product and approve it to be published on the website
Pre-Conditions	Admin should be logged in the system and also on products list view page in the manage products section
Post-Conditions	Product is approved or rejected.
Special Requirements	There should be an approval request pending.

Basic Flow			
Actor Action		**System Response**	
1	Admin click on a store in manage products section.	2	Redirect the admin to a page showing all products of the store. Pending approval ordered on top.
3	Click on a particular product	4	Display all the attributes of the product.
5	Admin click on approve button at the bottom	6	System will approve the product and publish on the website and notify the store.
7	Admin click exit button.	8	Display list of products.
Alternative Flow			
Actor Action		**System Response**	
5	Admin click on reject button alongside the approve button.	6-A	System will not publish the product on the website and notify the store.

3.7.11 Suspend Product

Name	Suspend product
Actors	Admin
Summary	Admin will be able to view and terminate a published product.
Pre-Conditions	Admin should be logged in the system and also on products list view page in the manage products section.
Post-Conditions	System will immediately suspend the product from the website.
Special Requirements	Product must already be published

Basic Flow			
Actor Action		**System Response**	
1	Admin click on a store in manage products section.	2	Redirect the admin to a page showing all products of the store. Pending approval ordered on top.
3	Click on a particular product	4	Display all the attributes of the product.
5	Click on “terminate” button at the bottom.	6	System suspends the product and exit product view page.
No Alternative Flow			

3.7.12 View Product

Name	View products
Actors	Admin
Summary	Admin will be able to see the attribute of a product
Pre-Conditions	Admin should be logged in the system and also on manage products section.
Post-Conditions	System will display the attributes and values of the product.
Special Requirements	None

Basic Flow			
Actor Action		**System Response**	
1	**Admin click on store entry in the table ordered based on approval requests.**	2	System will display the list of products sold by the store.
3	Admin click on a particular product from the table.	4	System will display the attributes and values of the product.
No Alternative Flow			

3.7.13 View home page

Name	View home page		
Actors	Stores		
Summary	User will be able to see all the products of their store.		
Pre-Conditions	User should be logged in.		
Post-Conditions	User successfully view all of their products		
Special Requirements	None		
Basic Flow			
	Actor Action		**System Response**
1	Store user logins successfully	2	System loads the home page with a list view of all products
Alternative Flow			
1	User clicks on the home from the navigation bar.	2-A	System loads the home page with a list view of all products

3.7.14 Add product

Name	Add product		
Actors	Stores		
Summary	User will be able to add products to their stores.		
Pre-Conditions	User should be on logged in.		
Post-Conditions	User added product to store successfully.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on Add product.	2	Create new product page is displayed, showing product detail, product description, product category, gallery and attachments needed to be filled.
3	User enters the details and press add button.	4	System checks the necessary fields needed to be filled and create that product and set “pending approval” for the product. System prompts the success message: *Product sent for approval.* Redirects the user back to home page.
Alternative Flow			
Actor Action		**System Response**	
3	User miss important fields and press save.	4-A	System highlighted the required fields in red and prompts the error message: *Please fill required fields!*

3.7.15 Delete a product

Name	Delete a product		
Actors	Store		
Summary	User will be able to delete a product from store.		
Pre-Conditions	User should be on logged in.		
Post-Conditions	User deleted a product successfully.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User select a product(s) from the home page.	2	System records the selections.
3	User clicks on the delete button.	4	System pops a small window with a warning.
5	User selects, “I’m sure” button.	6	System deletes the selected products and prompts the successful message: *Products removed Successfully*.
Alternative Flow			
Actor Action		**System Response**	
5	User clicks “No” button.	6-A	System returns to the home page.

3.7.16 Update product

Name	Update product
Actors	Store
Summary	User will be able to update the attribute values of a product from store like price or availability.
Pre-Conditions	User should be on logged in.
Post-Conditions	User updated a product attribute value successfully.
Special Requirements	None

Basic Flow			
Actor Action		**System Response**	
1	User select a product from the home page.	2	System records the selection.
3	User clicks on the update button.	4	System displays an editable product form with values pre-filled.
5	User enters the details and press update button.	6	System checks the necessary fields needed to be filled and create that product and set “pending approval” for the product. System prompts the success message: *Product sent for approval.* Redirects the user back to home page.
Alternative Flow			
Actor Action		**System Response**	
5	User miss important fields and press save.	6-A	System highlighted the required fields in red and prompts the error message: *Please fill required fields!*
5	User clicks ‘cancel’	6-A	Redirects the user back to home page.

3.7.17 Give Feedback

Name	Give feedback		
Actors	Client		
Summary	User will be able to give feedback on products bought.		
Pre-Conditions	User should be logged in. User should have bought the product. User should be on the product details page.		
Post-Conditions	User's feedback will be stored.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User will give feedback for the bought product by using star ratings.	2	System will store user's feedback in the database.
No Alternative Flow			

3.8 GUI

3.8.1 Admin panel

This GUI shows login page for an admin.

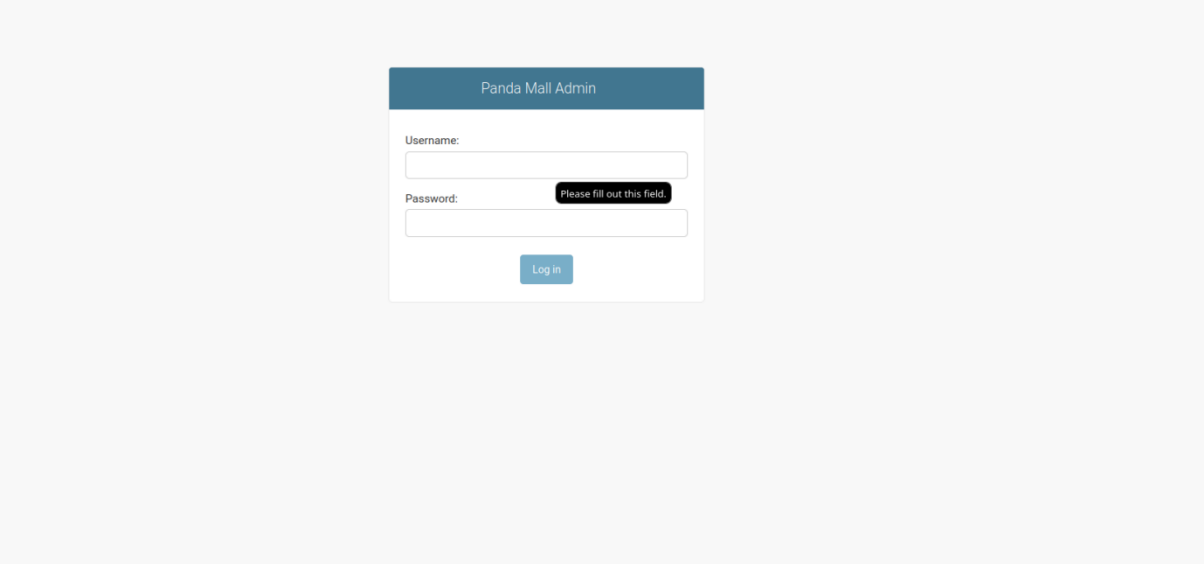

Figure 2: Login Screen
Admin panel login screen.

This GUI shows the “Manage Products” section of the admin panel.

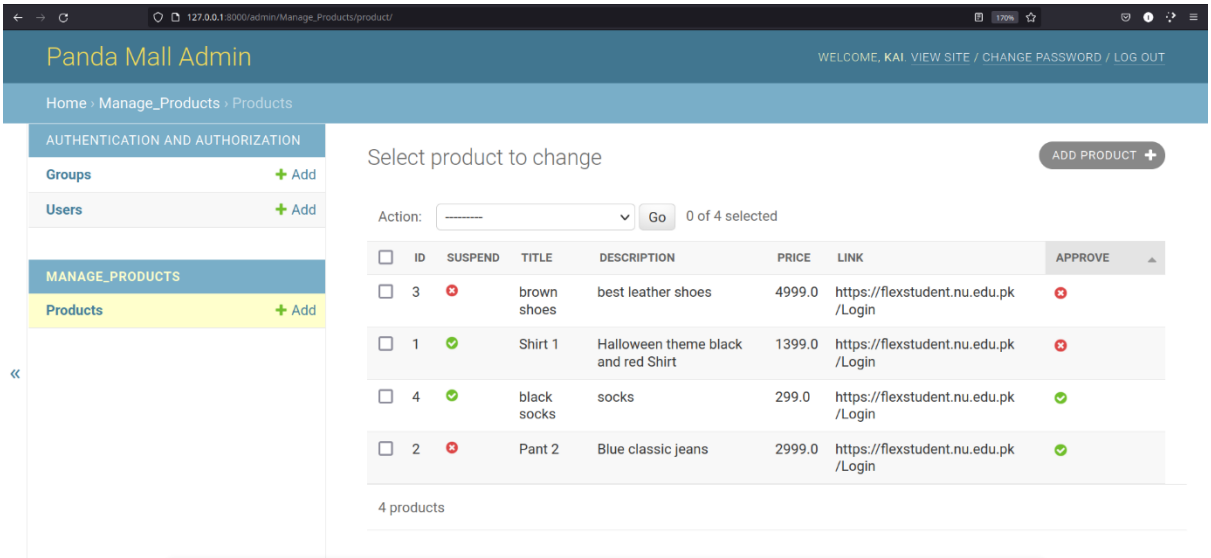

Figure 3: Manage Products
Manage Products Section

This GUI shows the edit page where an admin can approve, reject or suspend a product.

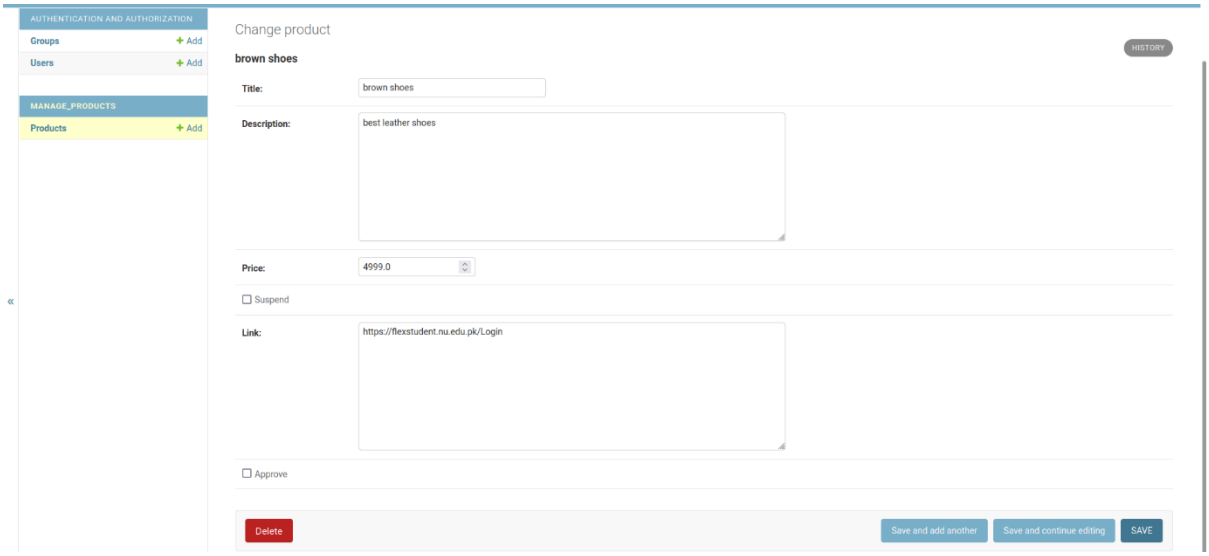

Figure 4: Update product page
Update product page at admin panel

3.8.2 Store GUI

This GUI shows the home page of a store.

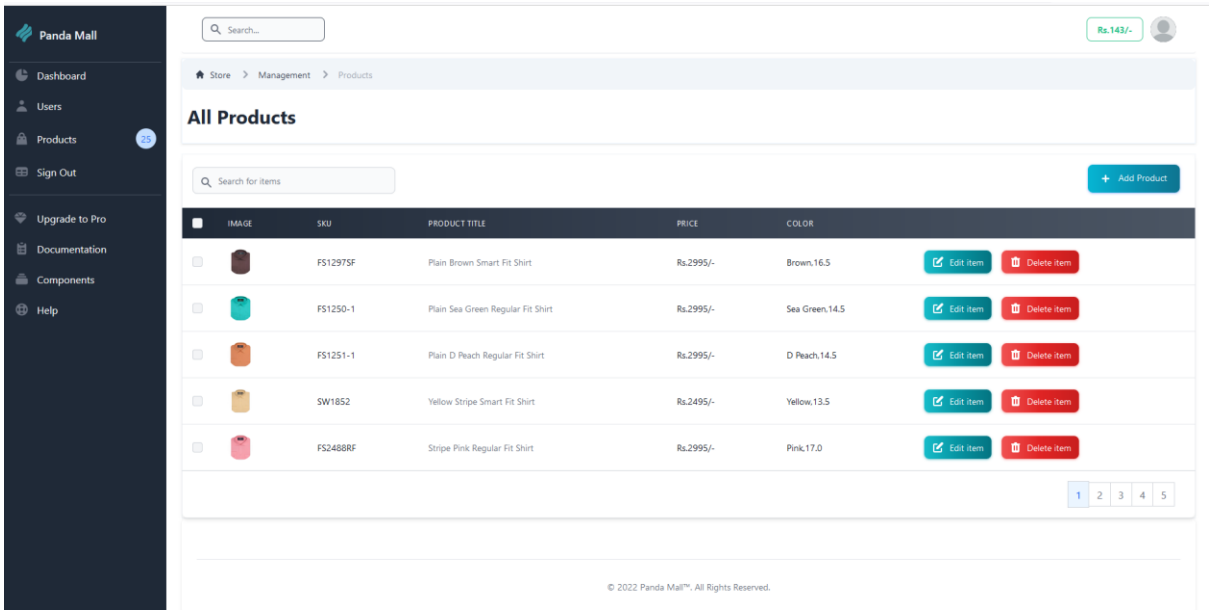

Figure 5: Store home page
Store home page

This GUI shows the delete pop up window before a product is deleted.

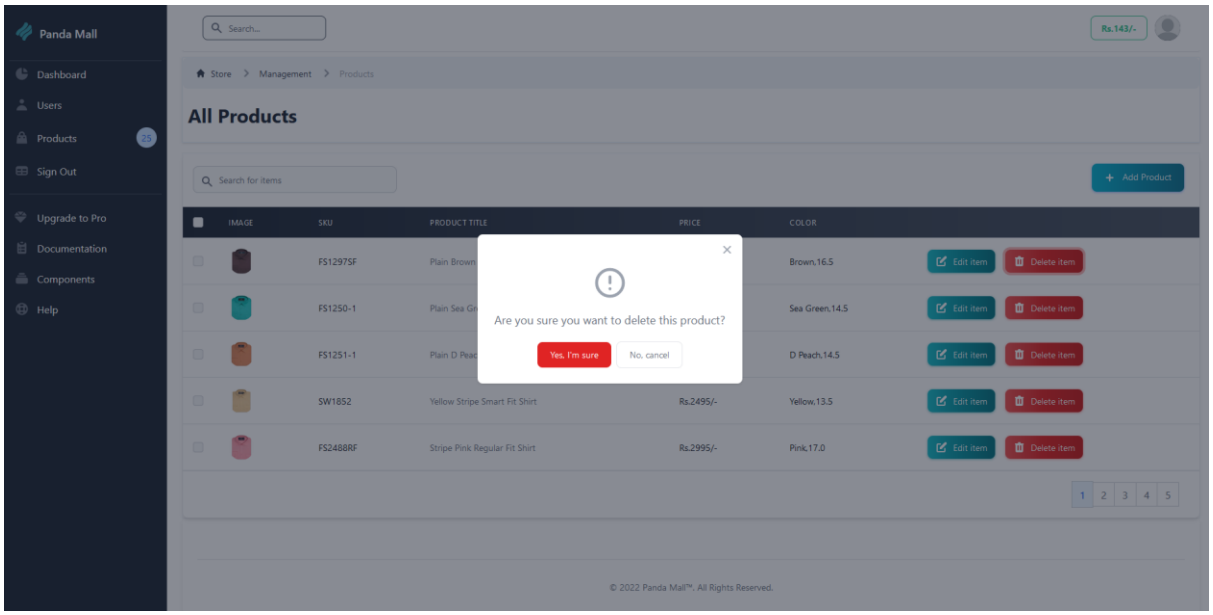

Figure 6: Pop up window
Pop up window when delete button clicked

This GUI shows the details of a product and allows to edit the product. This GUI is same for add products and update as the latter has prefilled values.

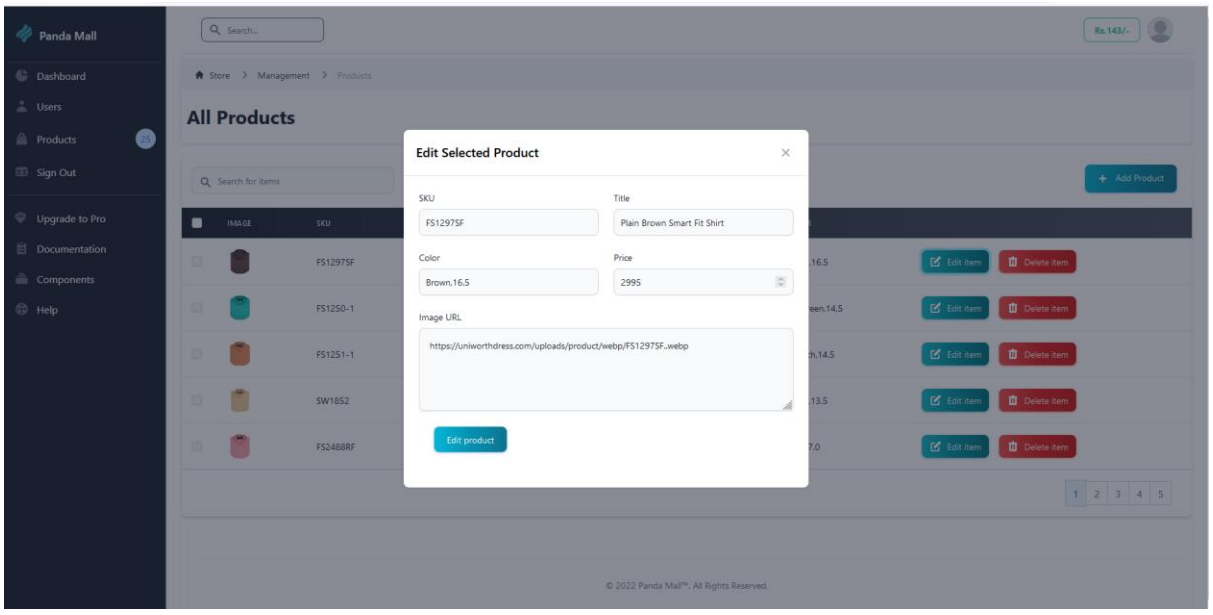

Figure 7: Edit product
Edit product page for store type user

3.8.3 Login GUI

This GUI shows the login page of our website.

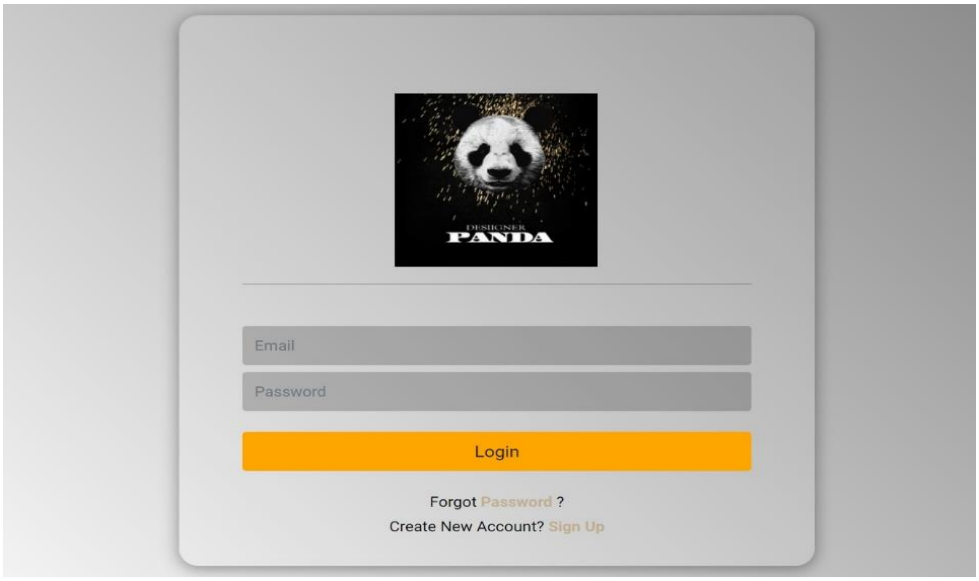

Figure 8: Login page
Website's login page

3.8.4 Sign Up GUI

This GUI shows the Sign-Up page of our website.

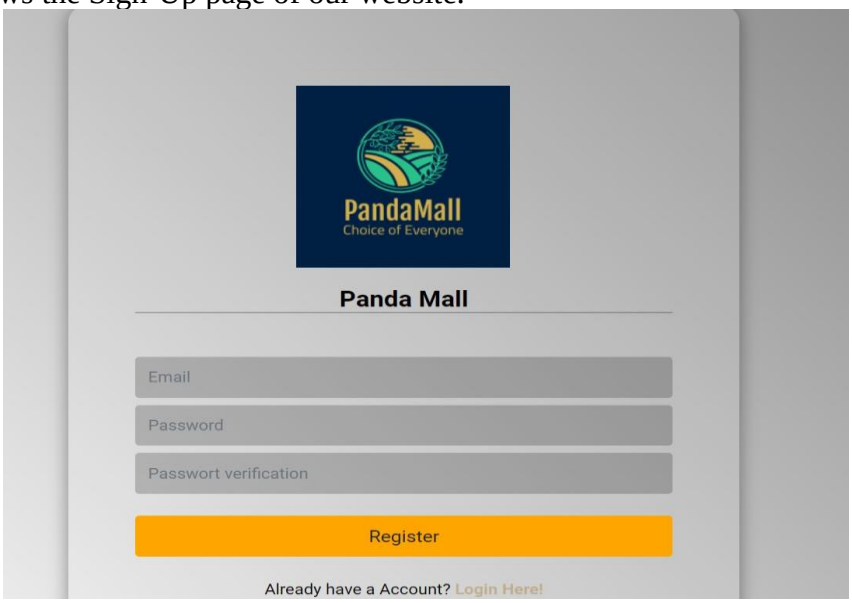

Figure 9: Sign Up page
Website's sign-up page

3.8.5 User/Client Pages GUI

This GUI shows the favourites page of our website. All of user's favourites products are placed on this page.

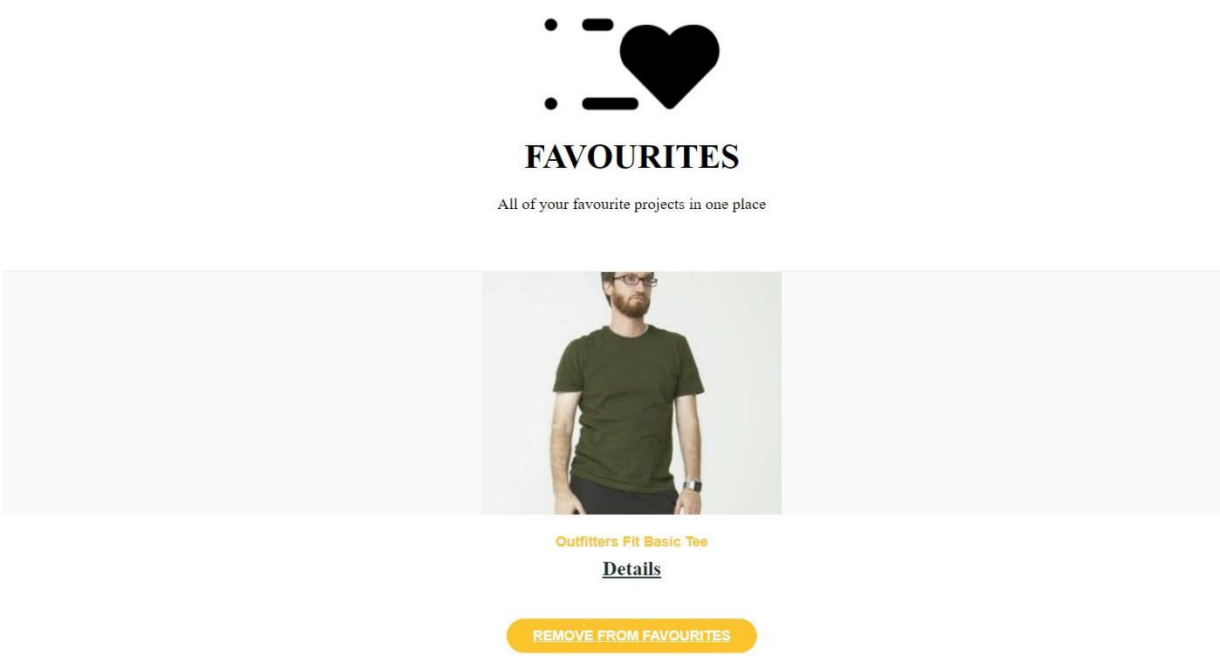

Figure 10: Favorite's page
Website's favourites page

This GUI shows the product details pop up window of our website. From this page we can buy a product along with viewing its details. Moreover, we can give feedback of a product that we have bought.

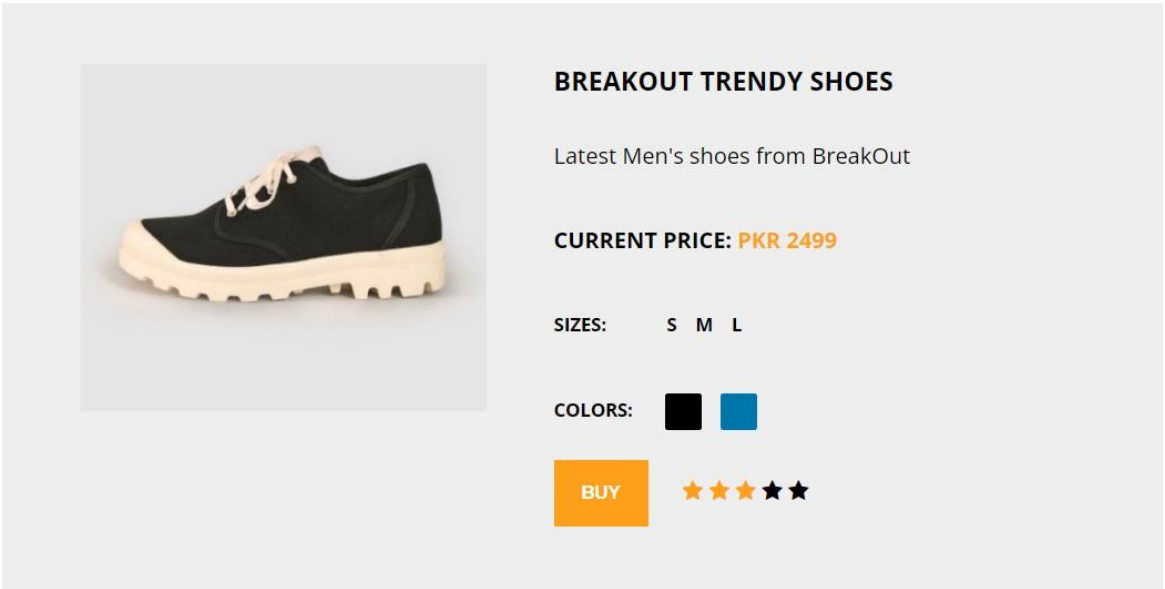

Figure 11: Product Details page
Products Detail page

This GUI shows the Home page for the user where user can see products to buy from. User can add product to favorite's list, can see the details of the product. Also, user can use filters to filter out specific product. User can also search a specific product and also can see his profile.

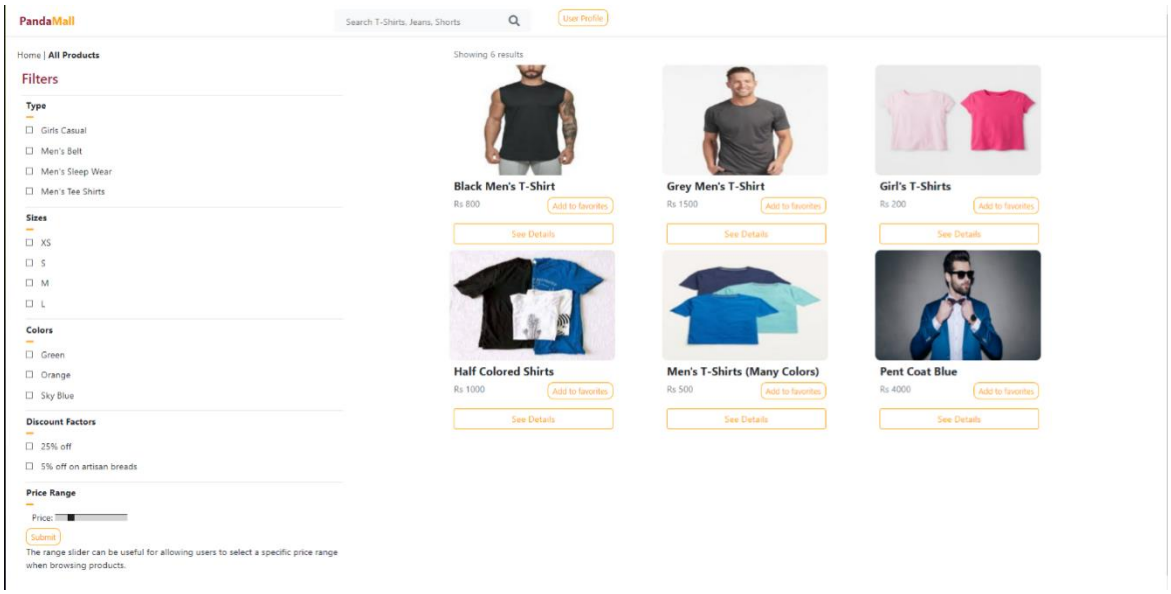

Figure 12:3 Home Page
Home page containing products

This GUI shows the User's profile where he can see his information. User can access feedback page and favorite's page from here as well. Also user can sign out from here as well.

Figure 13: Profile page
Profile containing user information

3.9 Database Design

3.9.1 ER Diagram

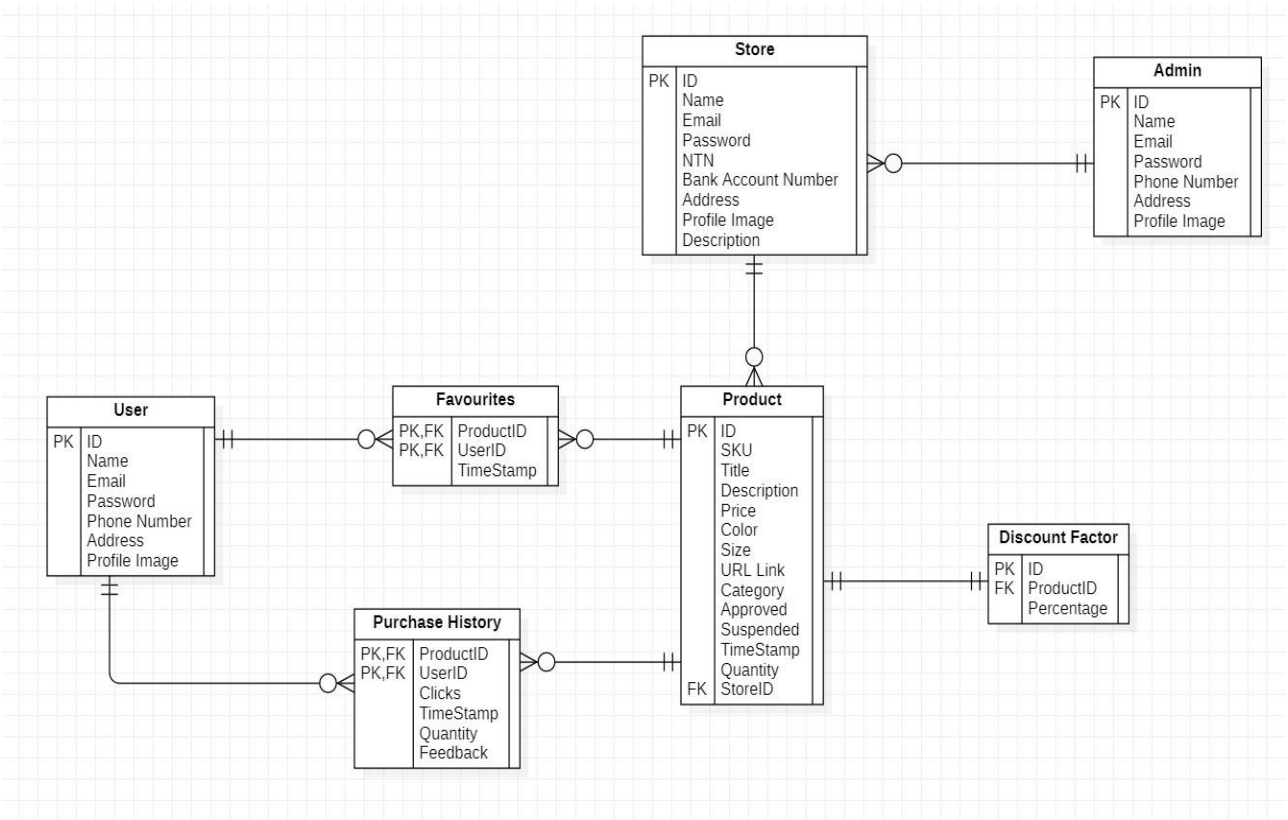

Figure 14: ER Diagram
This shows the ER Diagram of our system database

3.9.2 Data Dictionary

3.9.2.1 User

Table 1: User Data Dictionary
This is the data dictionary of user.

Fields	Data Types	Example
ID	Long	1992
Name	String	Ben White
Email	String	benwhite@gmail.com
Password	String	ArsenalFC
Phone Number	String	0321-xxxxxxx
Address	String	852-B Milaad St, Block B Faisal Town, Lahore, Punjab 54770
Profile Image	String	myWebsite.com/proiflepic.jpg

3.9.2.2 Favourite

Table 2: Favourites Data Dictionary
This is the data *dictionary of favourites.*

Fields	Data Types	Examples
ProductID (FK from ID of Product table)	Long	221
UserID (FK from ID of Product table)	Long	1919
TimeStamp	datetime	2016-12-21 00:00:00.000

3.9.2.3 Product

Table 3: Product Data Dictionary
This is the data dictionary of Product.

Fields	Data Types	Examples
ID	Long	23
SKU	String	K91919
Title	String	Shorts
Description	String	Any description
Price	Float	99.99
Color	String	Red
Size	String	Medium
URL	String	My-website.com/product=10
Category	String	Men
Approved	Boolean	True
Suspended	Boolean	False
TimeStamp	DateTime	2016-12-21 00:00:00.000
Quantity	Int	10
StoreID (FK)	Long	101

3.9.2.4 Purchase History

Table 4: Purchase History Data Dictionary
This is the data dictionary of Purchase History.

Field	Data Types	Examples
ProductID (PK, FK)	Long	23
UserID (PK, FK)	Long	12
Clicks	Int	20
TimeStamp	DateTime	2016-12-21 00:00:00.000
Quantity	Int	15
Feedback	String	Great Product

3.9.2.5 Store

Table 5: Store Data Dictionary
This is the data dictionary of Store.

Field	Data Types	Examples
ID	Long	7
Name	String	Tayyab
Email	String	tayyab@gmail.com
Password	String	Qwerty1234
NTN	String	231242134-9
Bank Account Number	String	HQM21HJ819
Address	String	134 A Muslim Town
Profile Image	String	myWebsite.com/proiflepic.jpg
Description	String	Detailed Info

3.9.2.6 Admin

Table 6: Admin Data Dictionary
This is the data dictionary of Admin.

Fields	Data Types	Examples
ID	Long	23
Name	String	Tayyab
Email	String	tayyab@gmail.com
Password	String	Tayyabqwerty
Phone Number	String	03401913211
Profile Image	String	myWebsite.com/proiflepic.jpg

3.9.2.7 Discount Factor

Table 7: Discount Factor Data Dictionary
This is the data dictionary of Discount.

Field	Data Types	Examples
ID	Long	3
ProductID (FK)	Long	29
Percentage	Float	70.1

3.10 System Requirements

3.10.1 Hardware Requirements

- A IOT device that supports a browser.
- Internet connection should have at least 1Mbps.
- A web server to host our website.

3.10.2 Software Requirements

- Web browser in the system.

3.11 Design Considerations

Before attempting to build a complete design solution, this section explains many of the challenges that must be addressed or overcome.

3.11.1 Assumptions and Dependencies

The assumptions or dependencies relating to the software and its use are listed below. These could include things like:

- User has a desktop with 2GB RAM and 64-bit Operating system.
- Users have JS enabled browsers installed.
- Users must have internet connection.
- User is familiar with understanding of basic e-commerce.

3.11.2 General Constraints

The global limits or constraints that have a substantial impact on the software design of the system are listed below:

3.11.2.1 Hardware or software environment

- We are designing a web application, so targeted systems should have JS supported browsers such as Google Chrome or Mozilla Firefox.

- In the case of hardware, web application requires 2 GB RAM, 64-bit OS.

3.11.2.2 End-user environment

- Users can utilize the online application with high-speed internet and a browser that supports the idea of web caching and cookies to save data for future use, as specified in the software requirements.

3.11.2.3 Availability or volatility of resources

- High speed and uninterrupted internet is required for better performance.

3.11.2.4 Interoperability requirements

- Client and server have to share and store data using common standards.

3.11.2.5 Interface/protocol requirements

- Http protocol will be used for communication between client and server.
- Interface will be implemented using react framework and running on browsers which are mentioned in software requirement.

3.11.2.6 Data repository and distribution requirements

- For web application data storage and retrieval, online cloud-based databases will be employed. It can only be changed by the administrator.

3.11.2.7 Security requirements (or other such regulations)

- System will be performing actions using secure protocols, secure the personal information of users by using the CSRF tokens for forms and data transfer.
- System will perform authentication and authorization.

3.11.2.8 Memory and other capacity limitations

- System requires CPU, Memory, I/O capacity, Bandwidth and cache space for better performance.

3.11.2.9 Verification and validation requirements (testing)

- The system will allow those users who have correct login credentials to conduct actions.

3.11.3 Language Constraints

- This system is only useful to those who are familiar with English language.

3.12 Development Methods

We chose the agile model, specifically the scrum method [2]. When it comes to development, the main justification for using the scrum model is its productivity and quality. In addition, this paradigm aids in the rapid development of our software. In addition, we held daily meetings with each other to keep track of our development and performance. Another advantage that drew us to this approach over others was its flexibility to adapt to changing requirements as we went along. We used the Scrum paradigm to break tasks into sprints, which simplified our job. Following were the steps in each sprint:

1. Planning
2. Implementation
3. Review
4. Retrospect

We initially examined two methods: the agile model, which we ultimately chose, and the prototype model. The following are the main reasons for not implementing the prototype model:

1. Poor documentation because of changing system requirements.
2. Incomplete problem analysis.
3. Increases the complexity of the system.

3.13 Class diagram

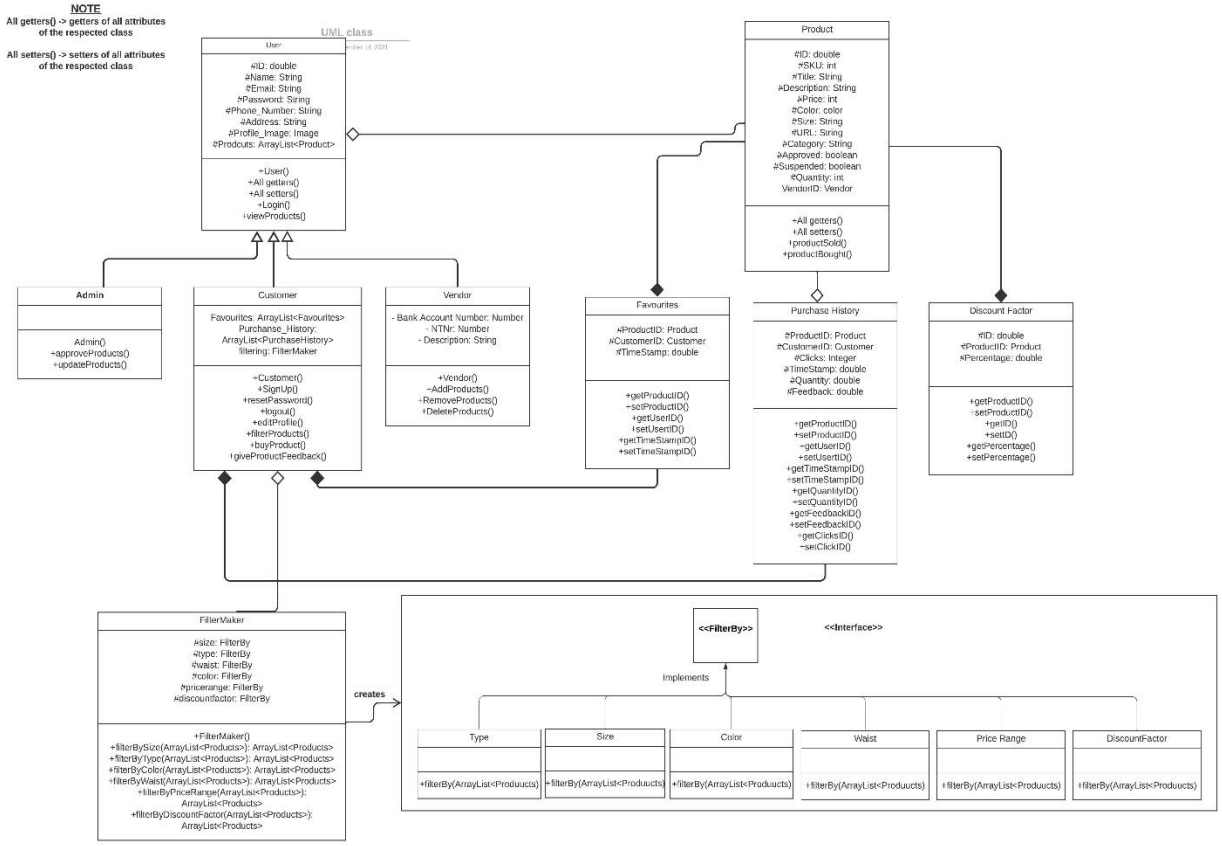

Figure 15: Class Diagram

Diagram for high level system architecture.

3.14 Sequence diagram

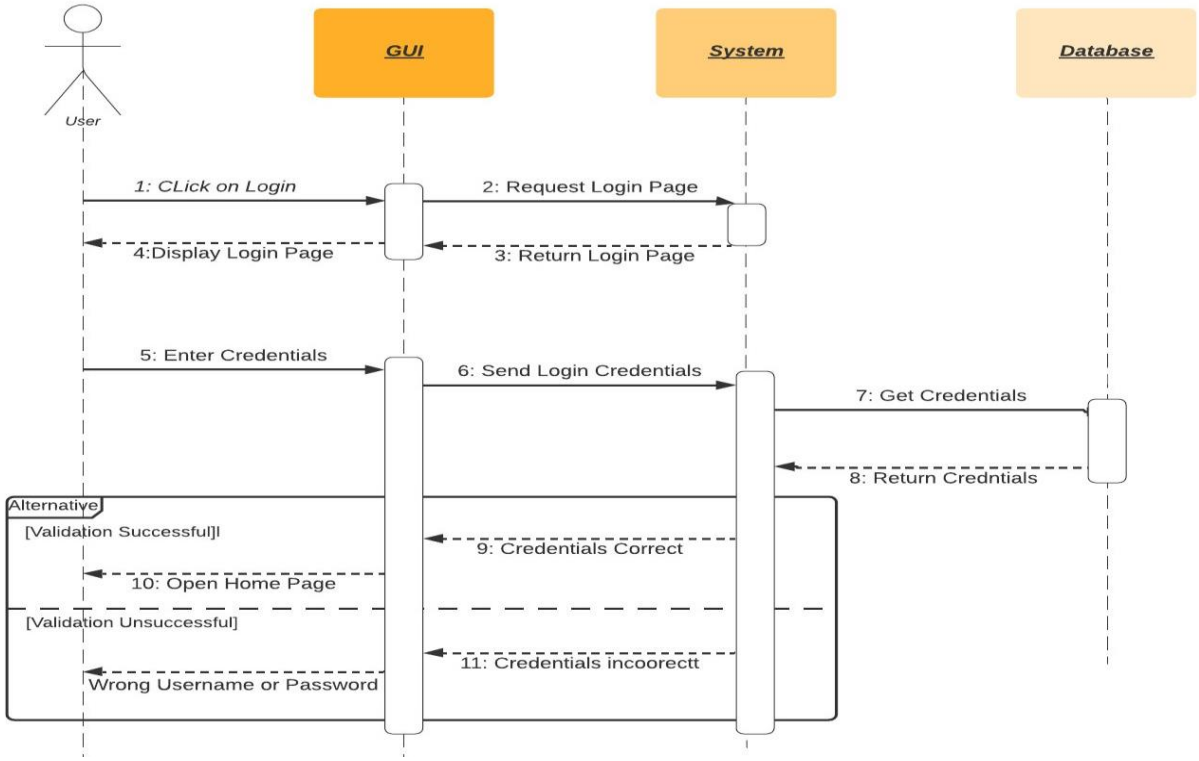

Figure 16: Login Account

This is the sequence diagram of Login Account for Users

.

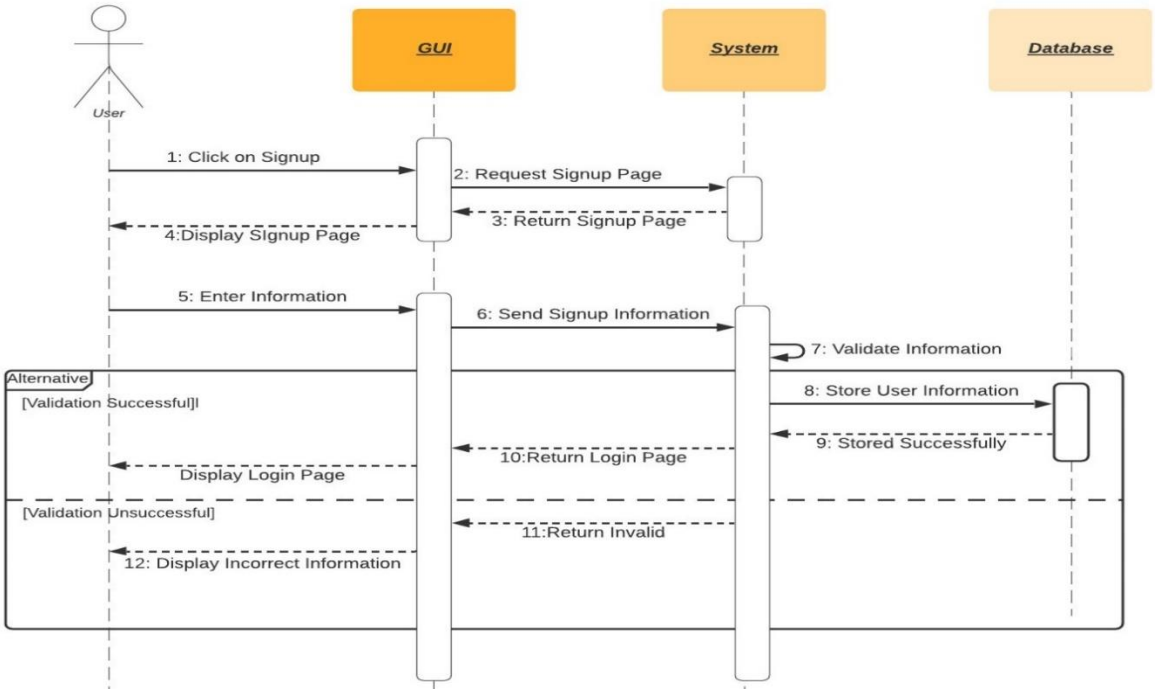

Figure 17: Create Account/Signup

This is the sequence diagram of Signup for Users.

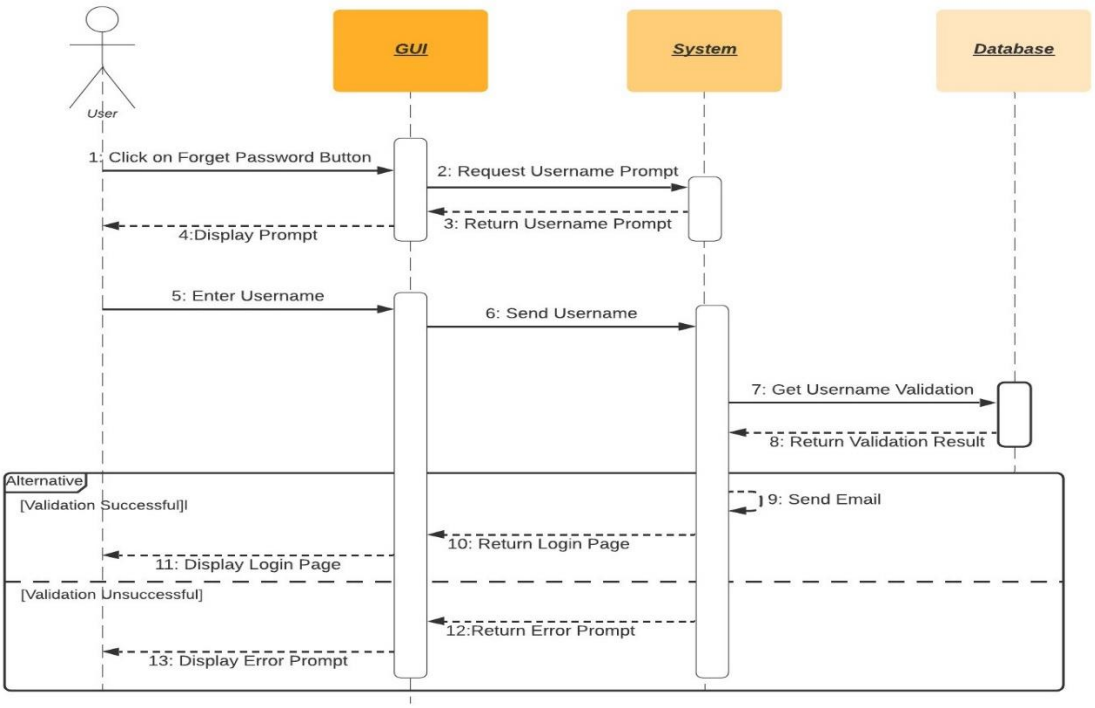

Figure 18: Reset/Forget Password

This is the sequence diagram of Reset/Forget Password for Users.

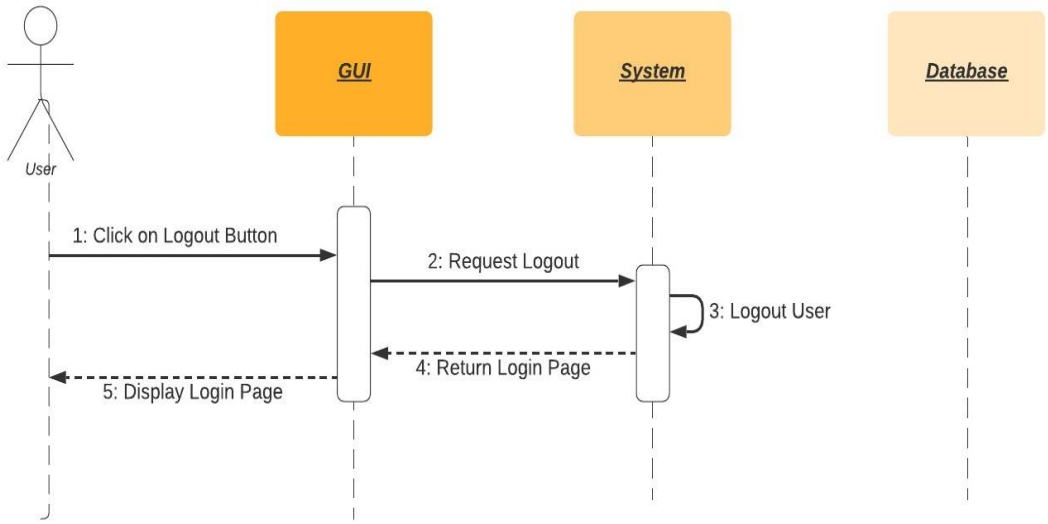

Figure 19: Logout

This is the sequence diagram of Logout Procedure for Users.

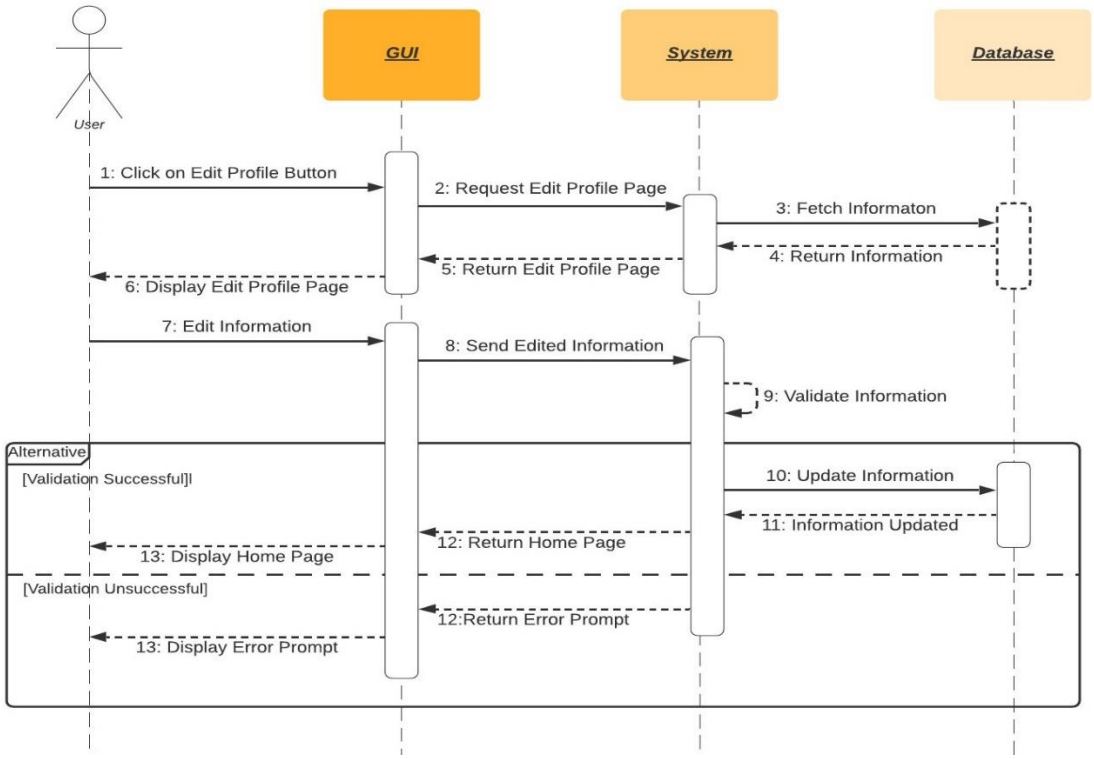

Figure 20: Edit Profile

This is the sequence diagram of Edit Profile for Users

.

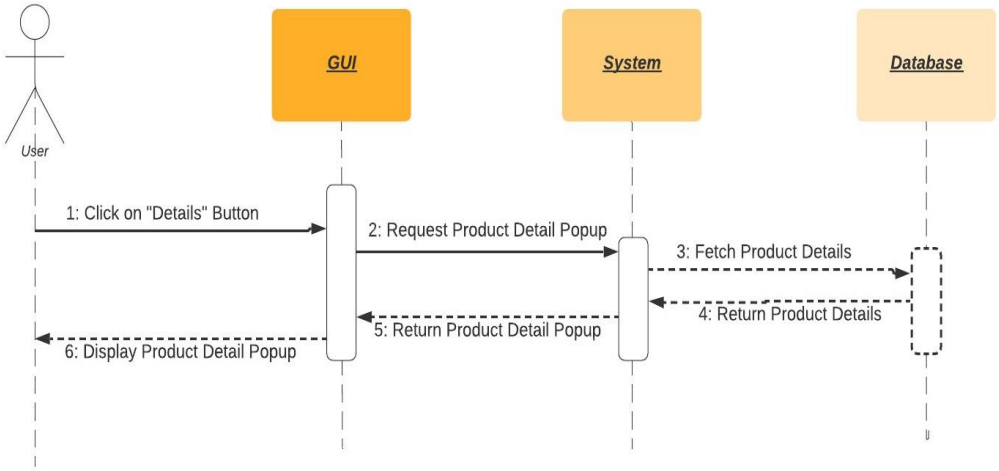

Figure 21: View Product Details

This is the sequence diagram of View Product Details.

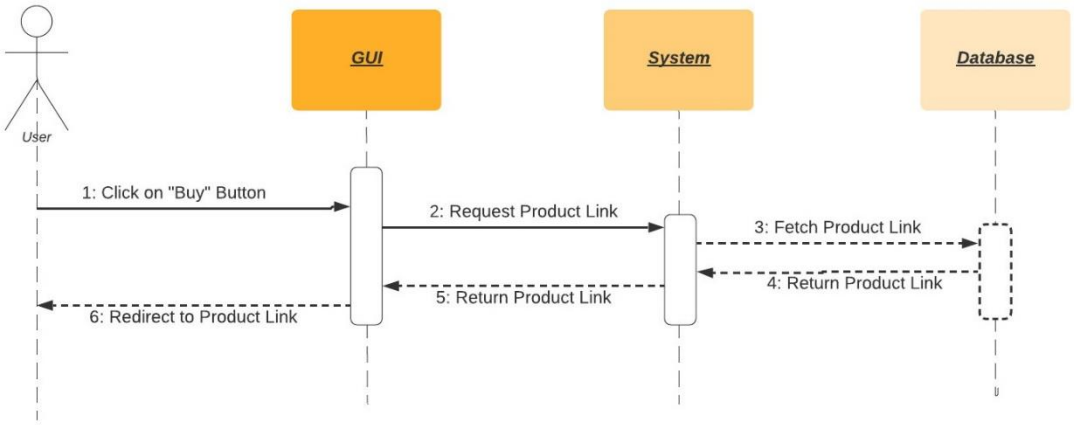

Figure 22: Buy Product
This is the sequence diagram of Buy a Product Procedure.

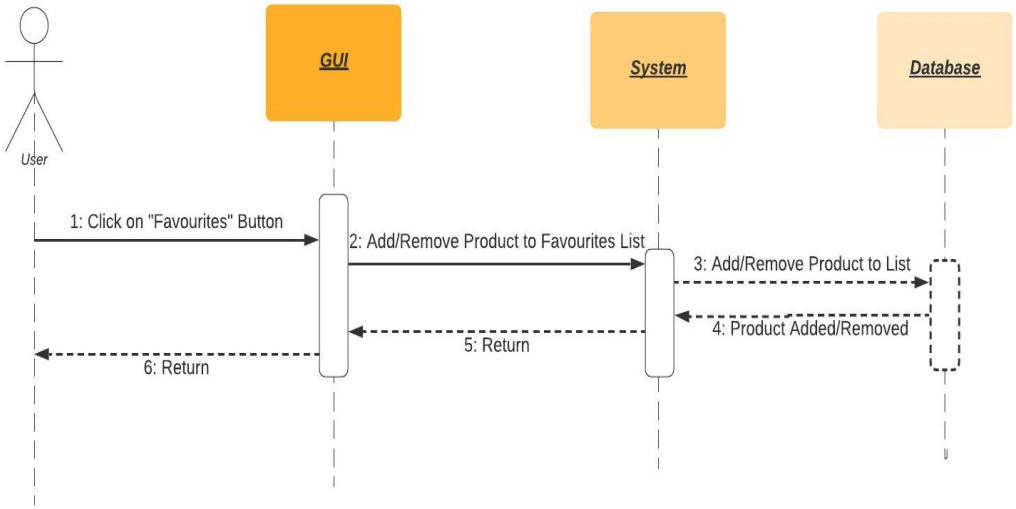

Figure 23: Add/Remove favorites
This is the sequence diagram of Removing and Adding Products from Favourites list

.

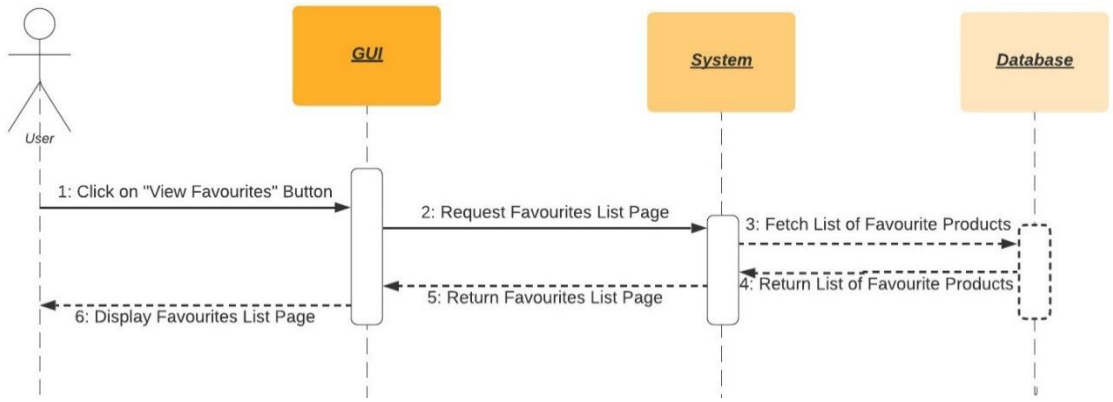

Figure 24: View Favorites List
This is the sequence diagram of Viewing Favourites List.

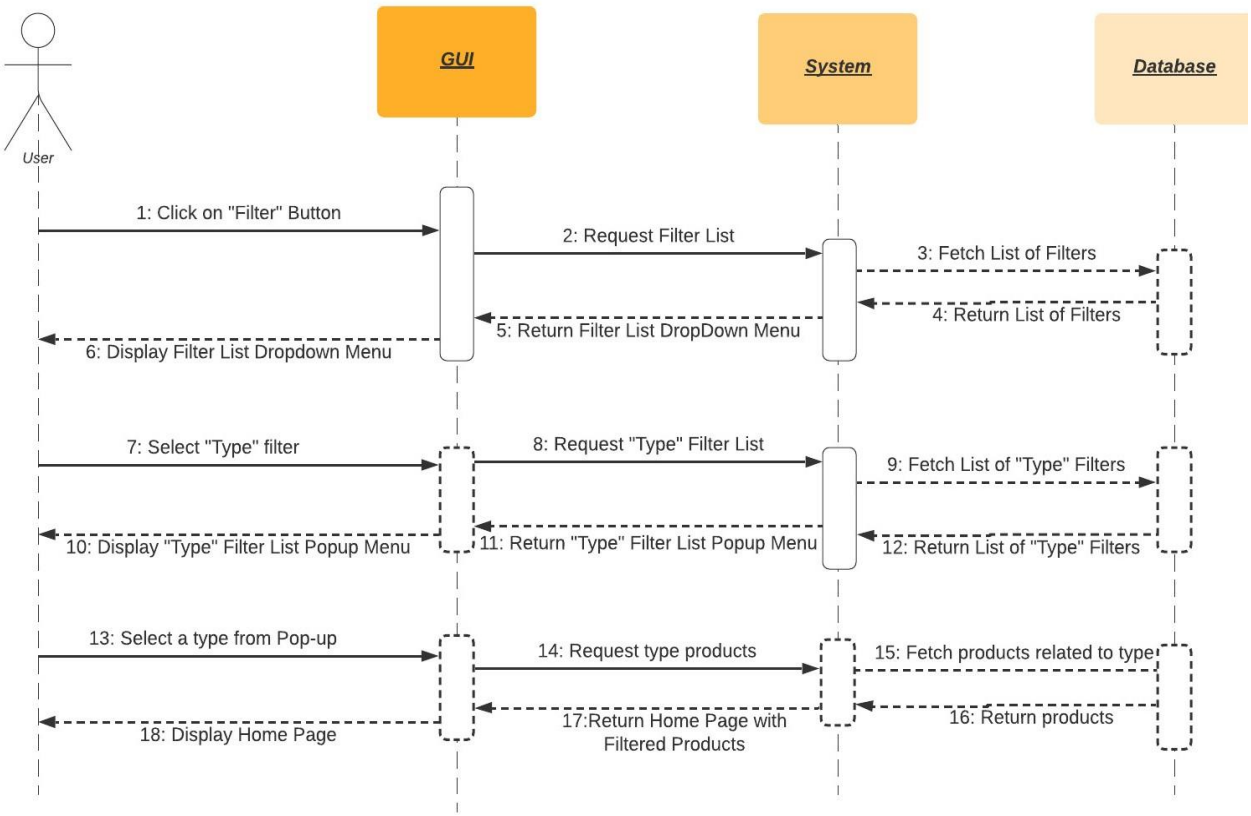

Figure 25: Filter by Type
This is the sequence diagram of filtering products by their "Type".

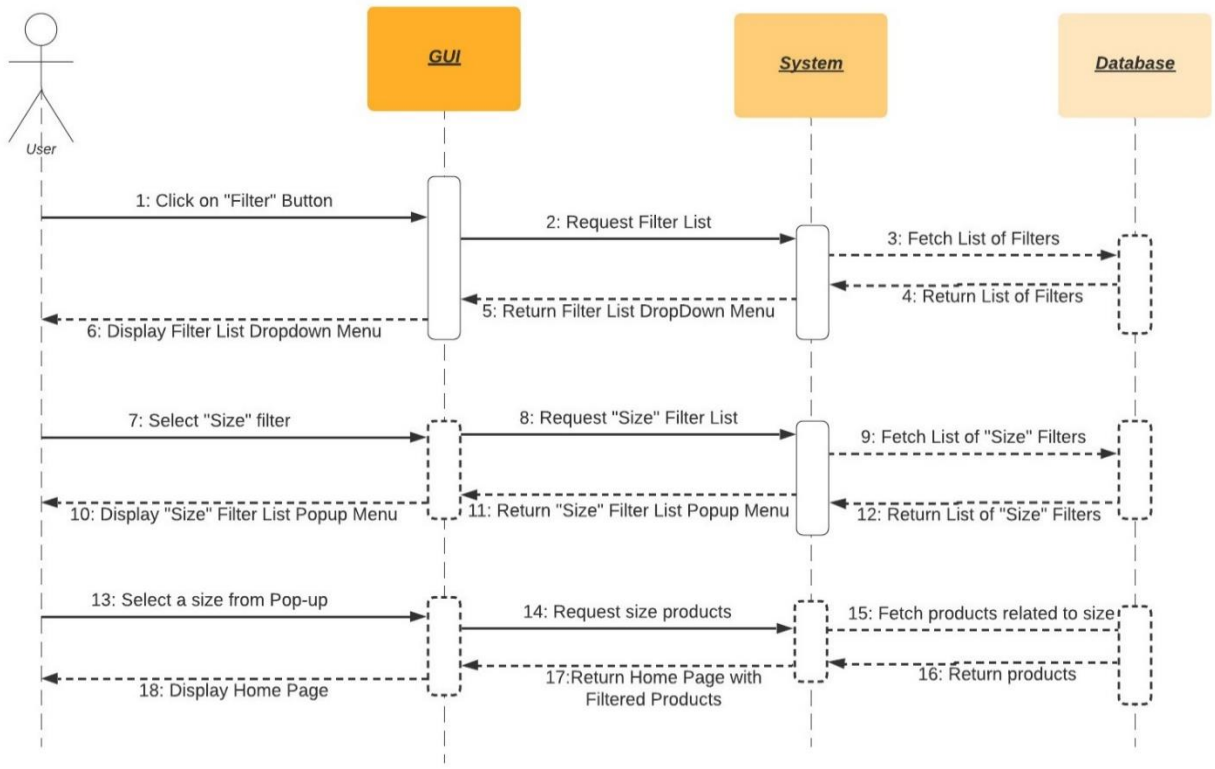

Figure 26: Filter by Size

This is the sequence diagram of filtering products by their "Size".

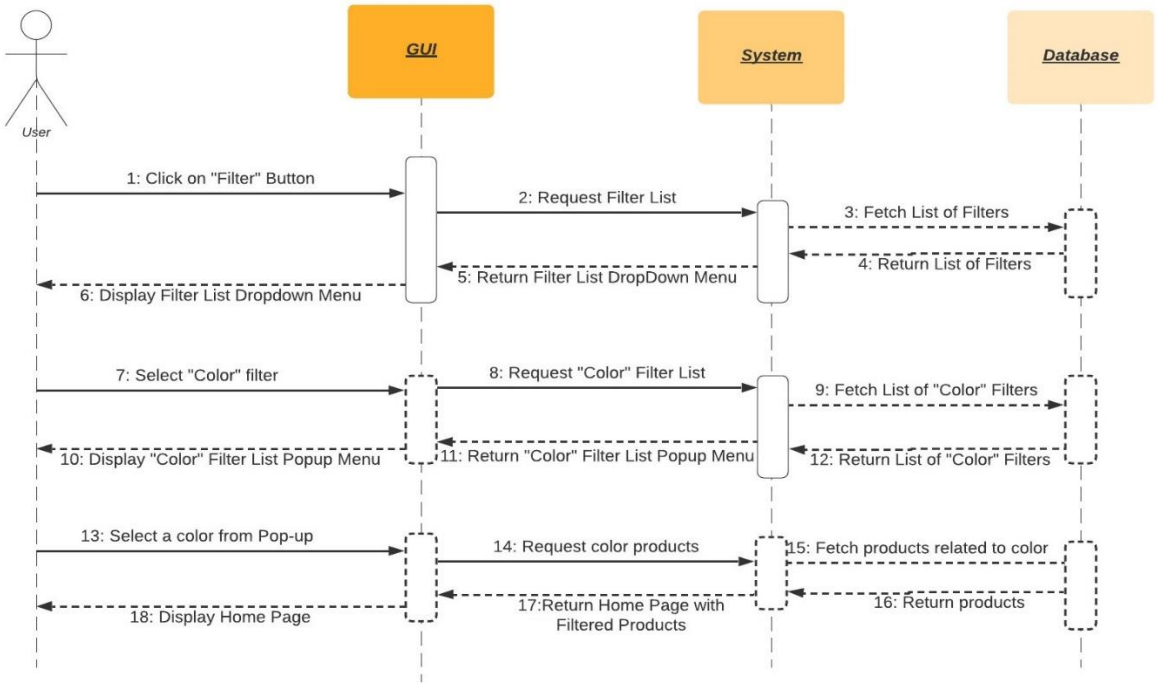

Figure 27: Filter by Color

This is the sequence diagram of filtering products by their "Colour".

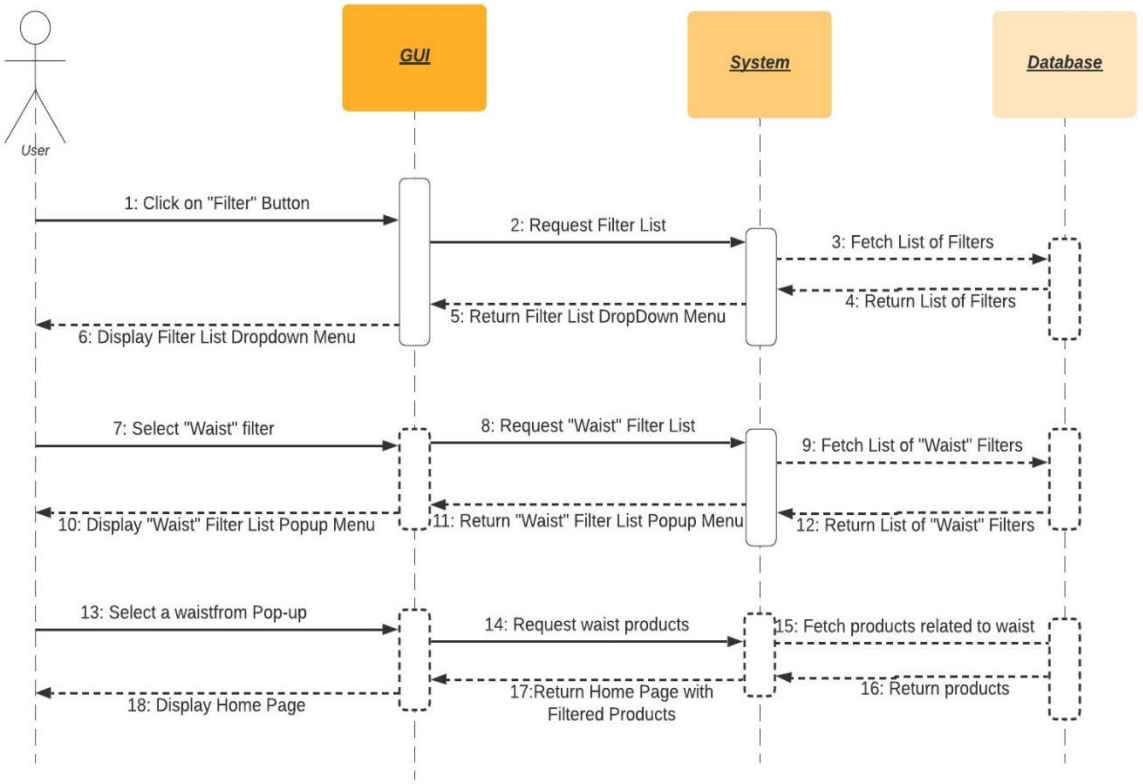

Figure 28: Filter by Waist

This is the sequence diagram of filtering products by their "Waist".

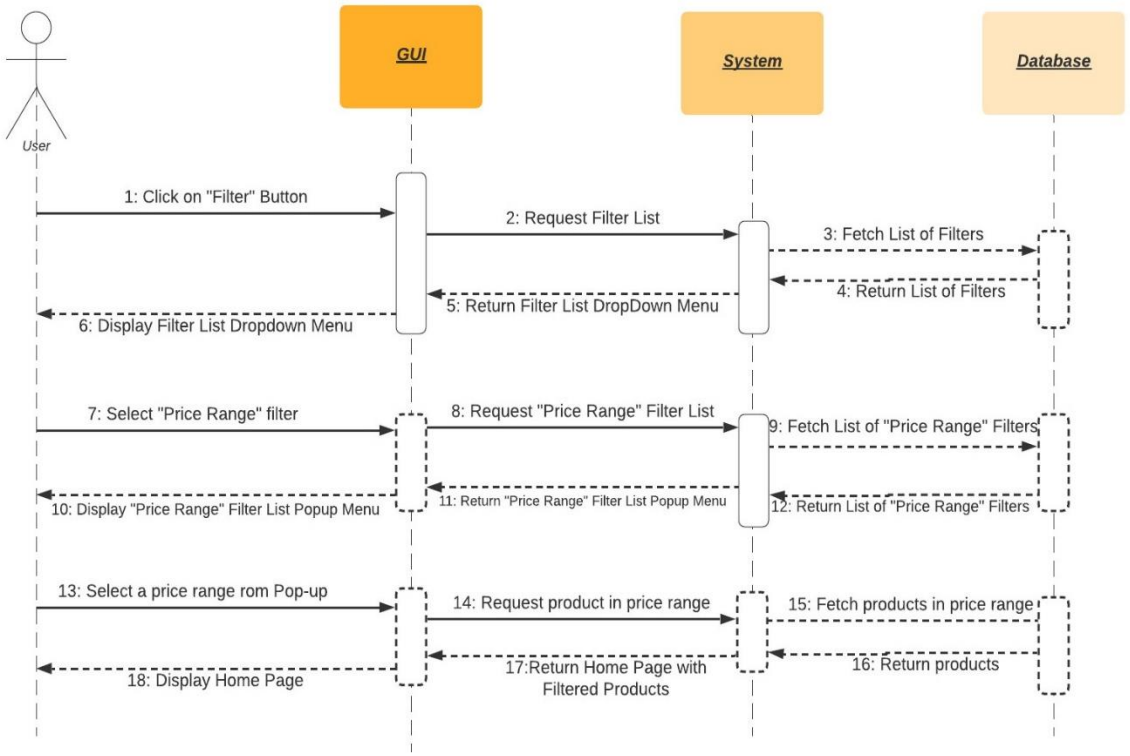

Figure 29: Filter by Price Range

This is the sequence diagram of filtering products by their "Price Range".

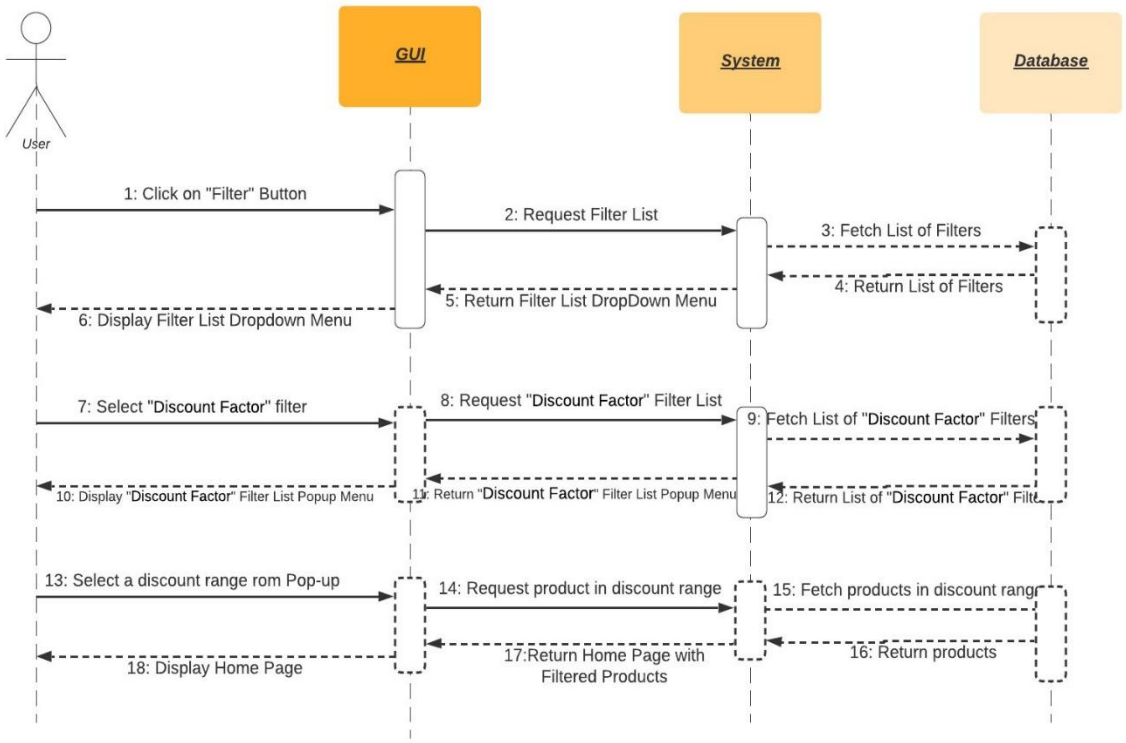

Figure 30: Filter by Discount Factor

This is the sequence diagram of filtering products by their "Discount Factor".

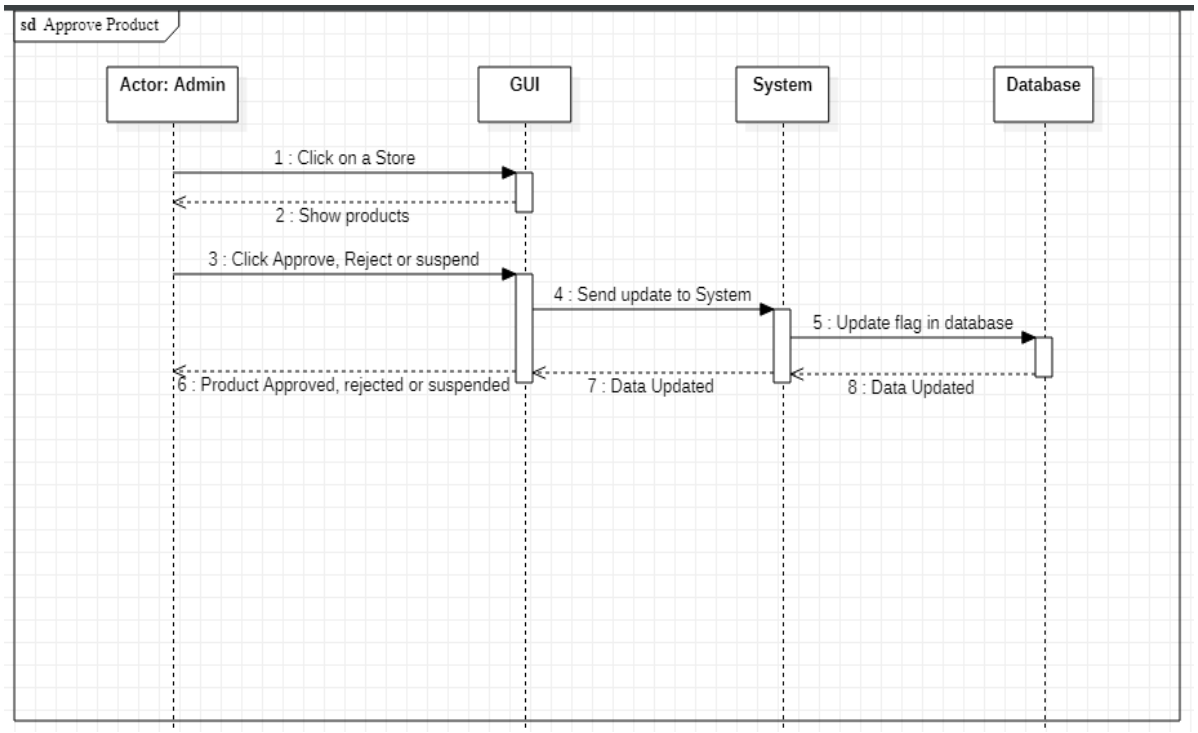

Figure 31: Product Approval

This is the sequence diagram of product approval, rejection or suspension.

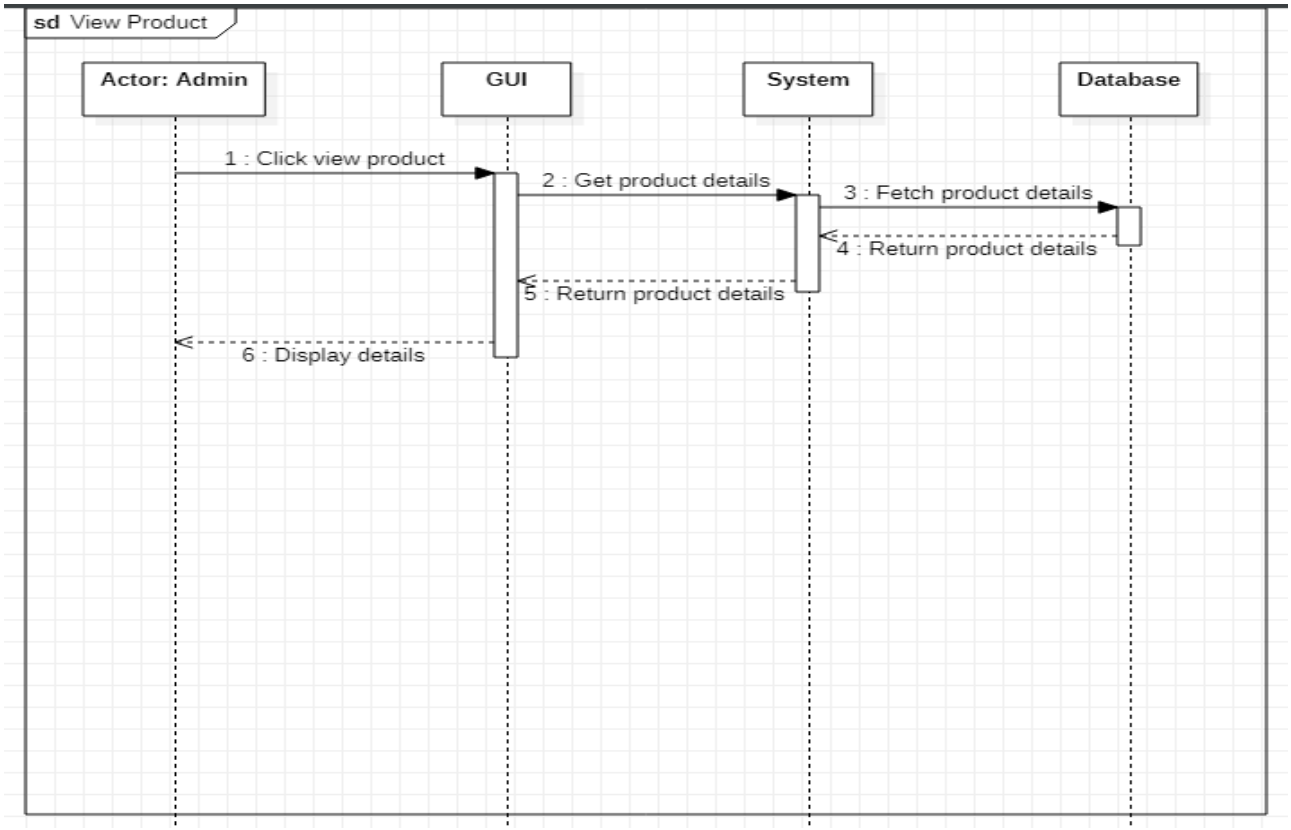

Figure 32: View Product

This is the sequence diagram of admin view product details.

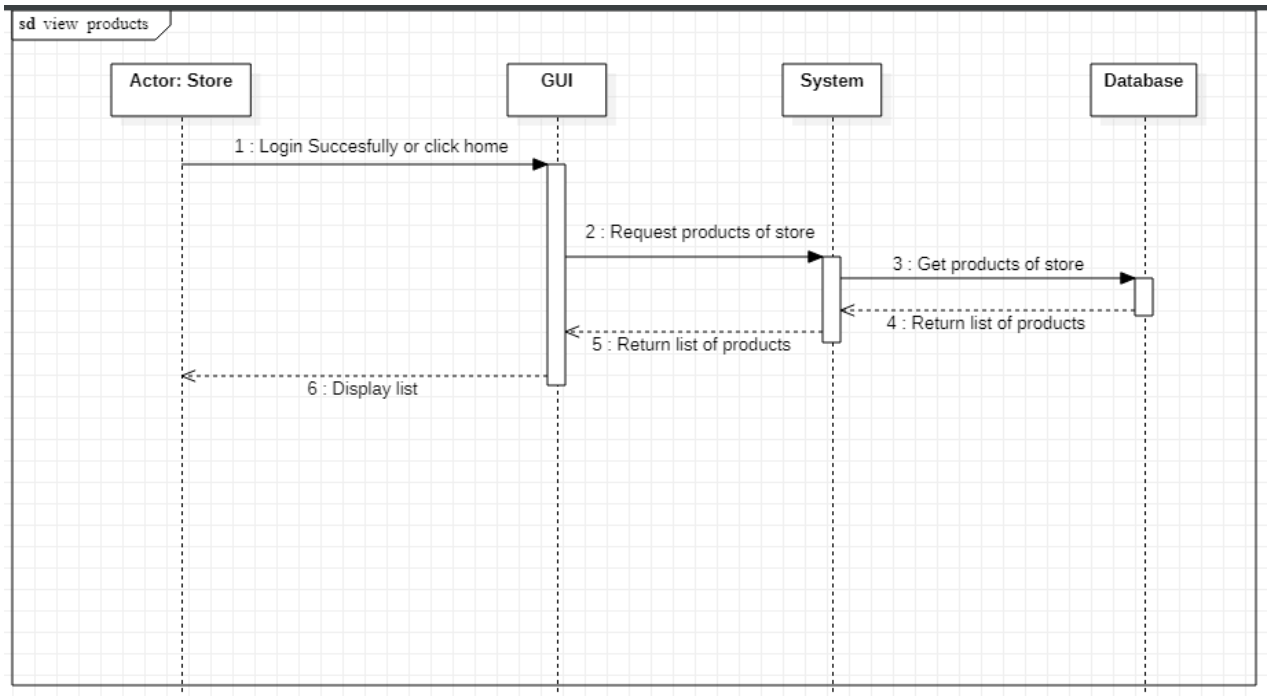

Figure 33: Home Page

This is the sequence diagram of store home page with product list.

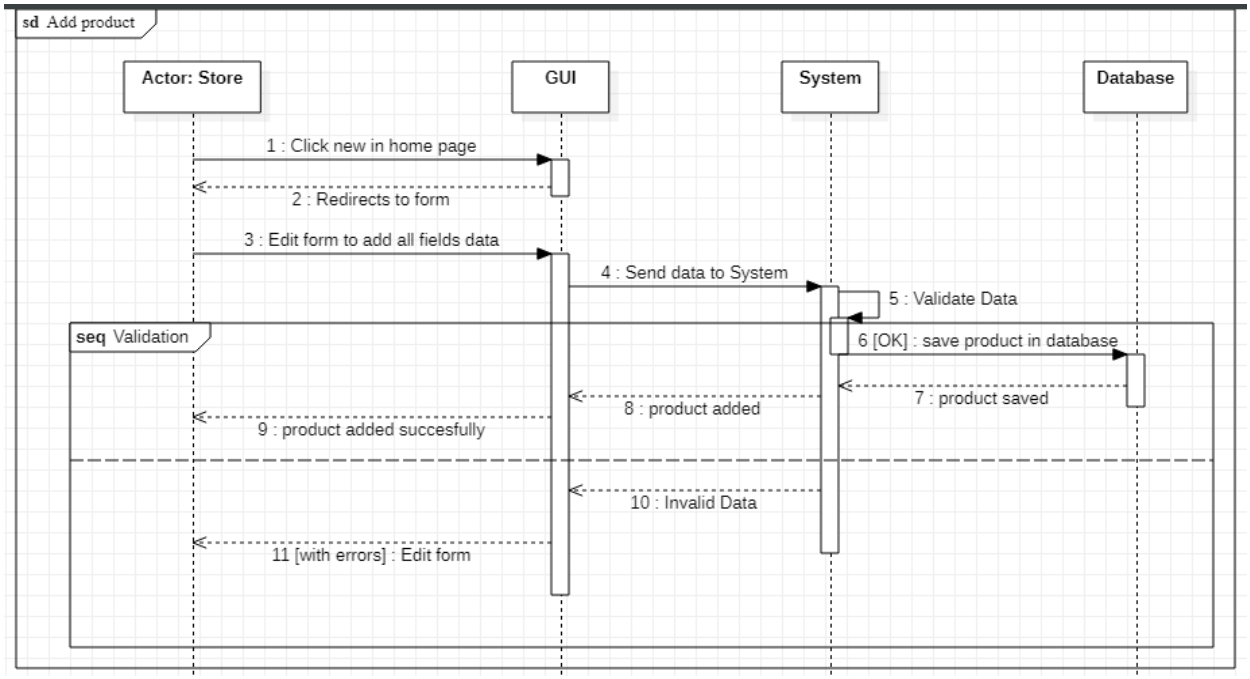

Figure 34: Add Product

This is the sequence diagram of store adding a product.

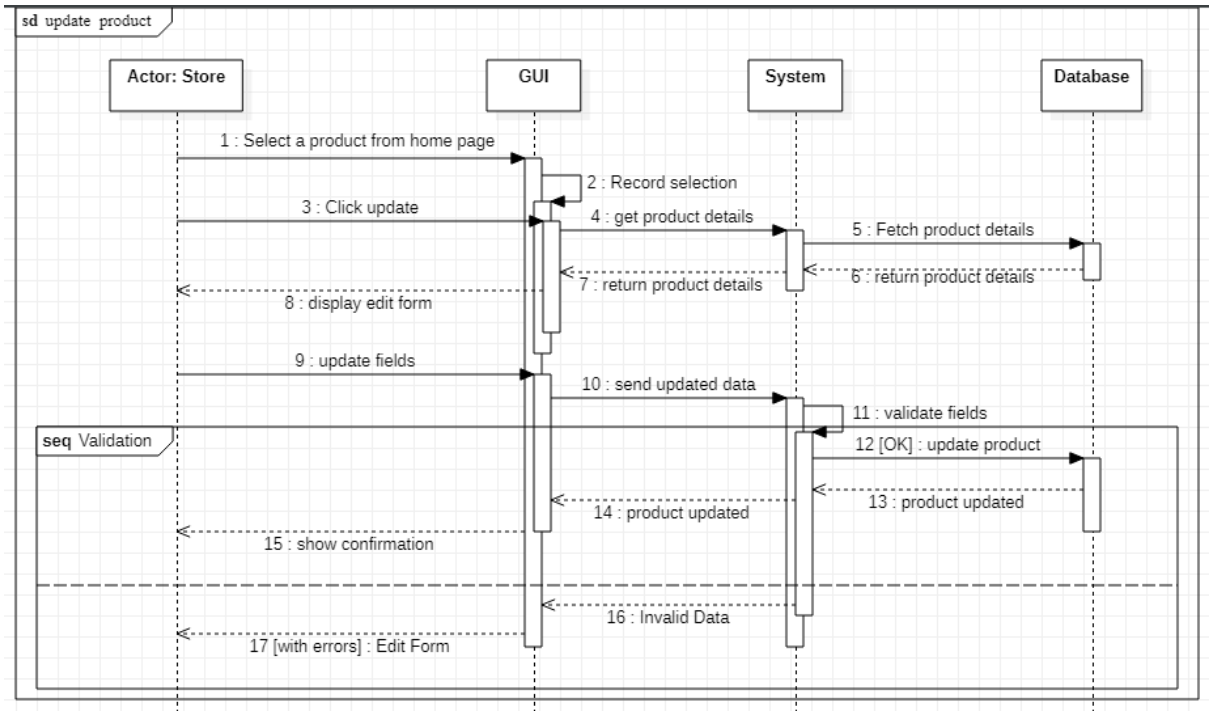

Figure 35: Update product

This is the sequence diagram of store updating a product.

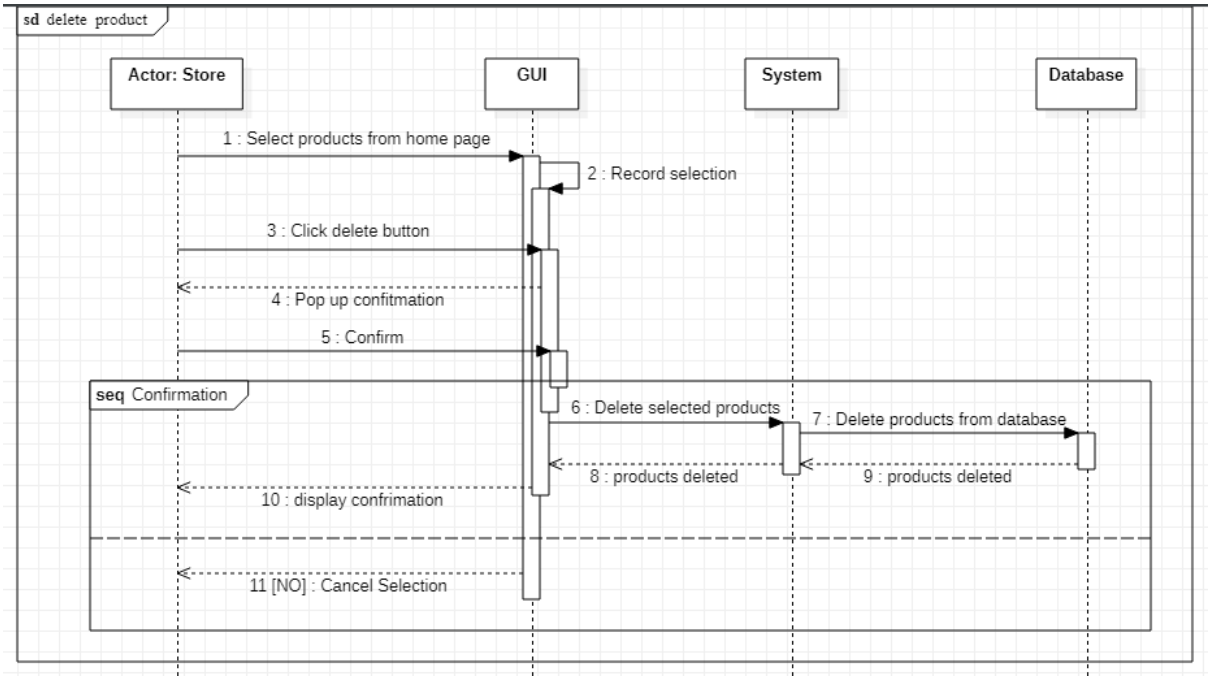

Figure 36: Delete Product

This is the sequence diagram of store deleting a product.

3.15 Policies and Tactics

3.15.1 Product to use

We will be using the latest version of python along with the Collaborative Filtering library. Moreover, we will use real-time database MySQL. For running our Python code, we will use PyCharm.

3.15.2 Coding guidelines and conventions

To make our code more structural and legible, all standard coding rules will be followed, including properly commented code and the use of OOP ideas while coding. Furthermore, as previously indicated, we will use Ben Schneiderman's 8 golden standards of UI design when creating our UI.

3.15.3 Testing the software

Acceptance testing, unit testing, functional testing, performance testing, stress testing, and usability testing are some of the testing methodologies we studied in software engineering.

Furthermore, we will collect testing data from our university students and run it through our algorithm, after which we will compare the output of our algorithm to the testing data to ensure that our system is accurate enough.

3.15.4 Maintaining the software

After project is completed, we will release improved versions of our software with added feature to assist the users. Moreover, we will fix any possible future faults in our system.

3.15.5 Protocol

Http protocol will be used for communication between client and server. Interface will be implemented using react framework and running on browsers which are mentioned in software

requirement. As we are using MongoDB, we will be storing data in JSON format hence data will flow over the network in JSON format.

3.15.6 Accessing the application

The web application would be hosted on cloud accessible with a URL link. Users having an account can access the application by going through the authentication procedure. In case a user doesn't have an account, he can sign up to make a new account. For vendors they must register their store on our website to add their products.

3.15.7 Choice of algorithm

We will use brute force approach along with different variants of collaborative filtering. We will choose the algorithm that gives us the best results.

3.15.8 Web Scrapping

We will scrap popular clothing brands website to retrieve their products by using a web scraping tool known as beautiful soup.

Chapter 4: Implementation and Test Cases

This chapter provides the implementation details of our prototype.

4.1 Implementation

Initially we have scraped data from websites of few popular clothing brands of Pakistan using Beautiful Soup which is a library of Python. After that we have cleaned the data and after that we worked on extracting the features from our data set that will help us to optimize the accuracy of our prototype. We ran our data on different types of Collaborative filtering algorithms alongside brute force approach in order to test the accuracy of these algorithm. Moreover, we collected data from volunteers using google forms to train our model. We have almost completed the frontend of our website and we are turning our focus onto the backend.

4.1.1 Dataset Collection

This project's data collection was created just for it. In this study, there were two sorts of datasets. We first required product information from a few well-known businesses. We scraped data from those brands using a website scraper. After that, we used a few of pre-processing procedures on it. To make it applicable to our model as a whole. The other dataset was gathered from university students and others in our usual surroundings. The dataset includes a sample of items from a few different companies. Each product had a rating scale ranging from 1 to 5, with a total of 50 goods to score. We acquired data from 50+ users through trusted sources. he data in the csv format sheet was included in the dataset. For use in the training model, the extracted data had to be preprocessed. The main problem with the dataset is that we were unable to gather it from a larger audience, and the number of goods was just too large for one user to score them all.

4.1.2 Dataset Preprocessing

Preprocessing on data is a must if you are looking to train a model using this data. So the data that we scrapped as well as the data that we collected had some issues that needed preprocessing in order to make the data feasible for the model. We did EDA on the data in order to find some kind of relationships and patterns in the data. We handled null values from our data by either removing those value or by doing imputation on it. We also replaced some string value with integers in order to make the data type similar across all the dataset.

4.1.3 Product Recommendation Model Implementation

We looked at four different options for implementing the concept. The first was dealing with our model in a basic manner. To create the forecast, our method simply sorted the results depending on the selling price of each product.

A decision tree algorithm was used in the second technique. At each step or node of a decision tree used for classification, we strive to construct a condition on the features in order to fully separate all of the labels or classes included in the dataset.

Collaborative filtering utilizing a model-based approach was the third option. Websites like Amazon, YouTube, and Netflix utilize a process called collaborative filtering. It eliminates products that a user could enjoy based on the reactions of other users. Memory-based and model-based collaborative filtering algorithms are the two types. Building machine learning algorithms to anticipate user ratings is part of the model-based approach. They use dimensionality reduction techniques to replace a large matrix with a lot of missing values with a much smaller matrix in a lower-dimensional space. The purpose of this exercise is to apply

SVD algorithms, experiment with different parameter combinations, and analyses the outcomes.
Grid Search Cross Validation is a cross-validation process to calculate accuracy metrics for an algorithm based on numerous parameter combinations. It's handy for determining the ideal parameter setup. As a consequence, the default value is the best for the vast majority of parameters. The benefit gained through Grid Search is negligible. The findings generated by the SVD model that delivered the best RMSE score were investigated in depth.
The fourth and last strategy was to use a collaborative filtering recommender system based on memory. Memory-based algorithms use statistical approaches to compute predictions over the full dataset. They're split into two categories: user-item filtering and item-item filtering. The User-Item technique entails identifying a group of users who are the most similar to the user U (based on their prior ratings) and calculating the rating for the item I using the ratings supplied by those users. The item-by-item technique involves determining a collection of the most comparable items to the item I (based on previous user ratings) and calculating the rating for the item I using the ratings of similar things rated by user U. Only Cosine similarity or Pearson correlation coefficients, which are exclusively based on mathematical operations, are used to compute the closest users or things. The system searches for a group of users with comparable transaction histories to the current user using statistical approaches. In the closest neighbor approach, this method is also known as nearest-neighbor or user-based collaborative filtering.
Memory-based collaborative filtering, on the other hand, performs poorly with high-sparsity data and has limited scalability for big datasets.

4.1.4 Website Implementation

We have almost completed our frontend implementation and now we are moving to implementing backend for our website. Following section describe the implementation details for our frontend and backend.

4.1.4.1 Frontend Implementation

We have made our frontend using React JS. We have used tailwind-CSS, bootstrap, material and HTML to make our frontend. Our frontend is divided in two sections based on different users, one for normal customers and the other one for admin and store owners. Initially both users will be shown a login page where they can login using their credentials or they can make a new account. If they try to login, they will be redirected to their respective home pages based on whether the user is a customer or a store owner. Login credential verification will be done by sending an API request to our backend.
A customer will be shown the recommended products on the home page along with a filter menu. A customer can also view the favorites page where he/she will be shown the list of his/her favorite products. Moreover, he/she can also update his/her profile by going to the profile page. All the updates will be updated in the database using API requests to the backend.
A store owner will be shown his stores products that he has added on our website. From there he/she can add, edit and delete products. Moreover, he can also view a summary of his store's financial situation which includes his total revenue generated etc.

4.1.4.2 Backend Implementation

We have decided to use Django (Python) in order to build our backend API. Our backend will be responsible to communicate with the database in order to efficiently respond to the API called from our frontend. It will respond to the API calls by sending the required data to our frontend.

4.2 Test Case Design and Description

4.2.1 Login Account

Login Module			
Test Case ID:	*1*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Login Account*
Revision History:	*None*		
Objective:	*User should be able to login successfully.*		
Product/Ver/Module:	*Login module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be registered in system.*		

Step No.	**Execution description**	**Procedure result**
1	*User opens the login page.*	*System displays login page asking for username and password.*
2	*Entered valid login credentials and pressed login button.*	*System verifies the credentials, establishes a session for the user and redirects the user to the home pages.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.2 Create Account

Login Module			
Test Case ID:	*2*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Create Account*
Revision History:	*None*		
Objective:	*User should be able to create his account successfully.*		
Product/Ver/Module:	*Signup module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should enter valid credentials.*		

Step No.	**Execution description**	**Procedure result**
1	*Clicked in Sign-up button from the login page.*	*System displays Sign-up page asking for required information.*
2	*Entered valid information and pressed submit button.*	*System verifies the information, creates a new account and redirects user to the home page.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.3 Reset Password

Reset Password			
Test Case ID:	*3*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Reset Password*
Revision History:	*None*		
Objective:	*User should be able to reset his account's password successfully.*		
Product/Ver/Module:	*Login module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be registered in the system.*		

Step No.	**Execution description**	**Procedure result**
1	*Clicked on "Forget Password" button from the login page.*	*System displays prompt asking for user's username.*
2	*Entered valid username and pressed submit button.*	*System verifies the username, sends an email to the user's email address*.
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.4 Email Verification

Email Verification			
Test Case ID:	*4*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Email Verification*
Revision History:	*None*		
Objective:	*User should have received the email containing the password.*		
Product/Ver/Module:	*Login module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet and user should have opened his/her Gmail.*		
Pre-Requisite:	*User should be have gone through the reset password procedure.*		

Step No.	**Execution description**	**Procedure result**
1	*Clicks on the view password button in the email.*	*System displays a password asking for user's username.*
2	*Entered valid username and pressed show password button.*	*System verifies the username and displays the password to the user.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.5 Logout

Logout			
Test Case ID:	*5*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Logout*
Revision History:	*None*		
Objective:	*User should be able to logout from his/her account successfully.*		
Product/Ver/Module:	*Logout module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*Clicks on the "Logout" button from the home page.*	*System will logout the user and redirect the user to the login page.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.6 View Profile

View Profile			
Test Case ID:	*6*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*View Profile*
Revision History:	*None*		
Objective:	*User should be able to view his/her profile information.*		
Product/Ver/Module:	*Profile module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*Clicks on the "Edit Profile" button from the home page.*	*System displays a new page containing user's current information.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.7 Edit Profile

Edit Profile			
Test Case ID:	*7*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Edit Profile*
Revision History:	*None*		
Objective:	*User should be able to edit his/her profile information.*		
Product/Ver/Module:	*Profile module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account and must be on the view profile page.*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "Edit Profile" button from the view profile page.*	*System displays the user's information in editable form.*	
2	*Entered updated information and pressed update profile button.*	*System validates the information and updates user's profile.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.8 View Product

View Product			
Test Case ID:	*8*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*View Product*
Revision History:	*None*		
Objective:	*User should be able to see the details of the selected product.*		
Product/Ver/Module:	*Product View module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account and must click on the "Details" button.*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "Details" button from the home page.*	*System displays a pop-up containing product details.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.9 Buy Product

Buy Product			
Test Case ID:	*9*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Buy Product*
Revision History:	*None*		
Objective:	*User should be able to buy a product from the brand's website.*		
Product/Ver/Module:	*Product Buy module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account and must click on the "Details" button of the selected product.*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "Buy" button from the product details pop-up.*	*System redirects the user to the respected link of the product.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.10 Add to Favorites

Add Favorites			
Test Case ID:	*10*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Add Favorites*
Revision History:	*None*		
Objective:	*User should be able to add a product to his/her favorites list.*		
Product/Ver/Module:	*Favorites module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account and selected product should not be in the favorites list*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "Favorites" icon from the selected product.*	*System adds the product to his/her favorites list.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.11 Remove from Favorites

Remove Favorites			
Test Case ID:	*11*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Remove from Favorites*
Revision History:	*None*		
Objective:	*User should be able to remove a product from his/her favorites list.*		
Product/Ver/Module:	*Favorites module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account and selected product should be in the favorites list*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "Favorites" icon from the selected product.*	*System will remove the product from his/her favorites list.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.12 View Favorites

View Favorites			
Test Case ID:	*12*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*View Favorites*
Revision History:	*None*		
Objective:	*User should be able to view his/her favorites list.*		
Product/Ver/Module:	*Favorites module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		
Step No.	**Execution description**	**Procedure result**	
1	*Clicks on the "View Favorite" button from the home page.*	*System redirects the user to the new page containing a list of user's favorite's items. If there are no products in the favorites list then empty list will be displayed.*	
Comments	The system works as expected.		
☒*Passed* ☐*Failed* ☐*Not Executed*			

4.2.13 Filter Products

Filter Products			
Test Case ID:	*13*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Filter Products*
Revision History:	*None*		
Objective:	*User should be able to filter products based on selected type..*		
Product/Ver/Module:	*Favorites module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*Clicks on the "Filter" button from the home page.*	*System displays a dropdown menu containing different types of filters.*
2	*Selects the "Type" filter from the dropdown menu.*	*System displays a pop-up of the types for clothing products.*
3	*Selects a type from the pop-up window.*	*System reloads the home page and displays the products based on the user's filtering criteria.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.14 View Home Page

Home Page			
Test Case ID:	*14*	**QA Test Engineer:**	*Muhammad Zain*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*View Home Page*
Revision History:	*None*		
Objective:	*User should be able to see all products of their store.*		
Product/Ver/Module:	*Favorites module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*Clicks on the "Home" icon from the navbar.*	*System displays all recommended products.*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.15 Approve Product

Approve			
Test Case ID:	*15*	**QA Test Engineer:**	*Asjad*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab Waseem*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Approve Product*
Revision History:	*None*		
Objective:	*Product is approved on the store.*		
Product/Ver/Module:	*Administration module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*Clicks on a particular product.*	*Display attribute of selected product*
2	*Click on approve Button*	*System publish and push an email notification*
	Click on suspend button	*System suspends and push an email notification*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.16 View Product

View Product			
Test Case ID:	*16*	**QA Test Engineer:**	*Asjad*
Test Case Version:	*1*	**Reviewed by:**	*Zain*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*View Product*
Revision History:	*None*		
Objective:	*List View of Products on store.*		
Product/Ver/Module:	*Store module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	.	*Display all products of store*
2	*Click on particular product*	*System display detail view*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.17 Add Product

Add Product			
Test Case ID:	*17*	**QA Test Engineer:**	*Asjad*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Add Product*
Revision History:	*None*		
Objective:	*Add a new Product in store.*		
Product/Ver/Module:	*Store module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*. Click on Add new product*	*Display a form of product details*
2	*Fill form and click "Add Product"*	*System add product for approval in store*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.18 Delete Product

Delete Product			
Test Case ID:	*18*	**QA Test Engineer:**	*Asjad*
Test Case Version:	*1*	**Reviewed by:**	*Tayyab*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Delete Product*
Revision History:	*None*		
Objective:	*Delete a Product from store.*		
Product/Ver/Module:	*Store module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*. Select on a particular product and click "delete"*	*Display a warning modal*
2	*Click on confirmation*	*Removes product from store*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.2.19 Update Product

Update Product			
Test Case ID:	*19*	**QA Test Engineer:**	*Asjad*
Test Case Version:	*1*	**Reviewed by:**	*Zain*
Test Date:	*14-05-2022*	**Use Case Reference(s):**	*Update Product*
Revision History:	*None*		
Objective:	*Update a Product from store.*		
Product/Ver/Module:	*Store module*		
Environment:	*Software: Any Modern Browser* *Hardware: Laptop*		
Assumptions:	*The computer of the user should be connected to Internet.*		
Pre-Requisite:	*User should be logged in to his/her account.*		

Step No.	Execution description	Procedure result
1	*. Select on a particular product and click "update"*	*Display a model form with prefilled fields*
2	*Enters updated field data and click "update" button*	*Product information is updated*
Comments	The system works as expected.	
☒*Passed* ☐*Failed* ☐*Not Executed*		

4.3 Test Metrics

The test metrics are discussed below:

Metric	Value
Number of Test Cases:	19
Number of Test Cases Passed:	19
Number of Test Cases Failed:	0
Test Case Defect Density:	0/10
Test Case Effectiveness:	10/10
Traceability Matrix:	Included in a separate file

Chapter 5: Experimental Results and Analysis

The experiments performed on the following Algorithms:

1. Naive Approach (Control)
2. Decision Tree
3. Support Vector Machines: Collaborative Filtering (Model based Approach)
4. Cosine Similarity: Collaborative Filtering (Memory based Approach)

Produced vastly different results on the accuracy and error. We found that the cosine similarity based collaborative filtering works best with our use case and dataset.

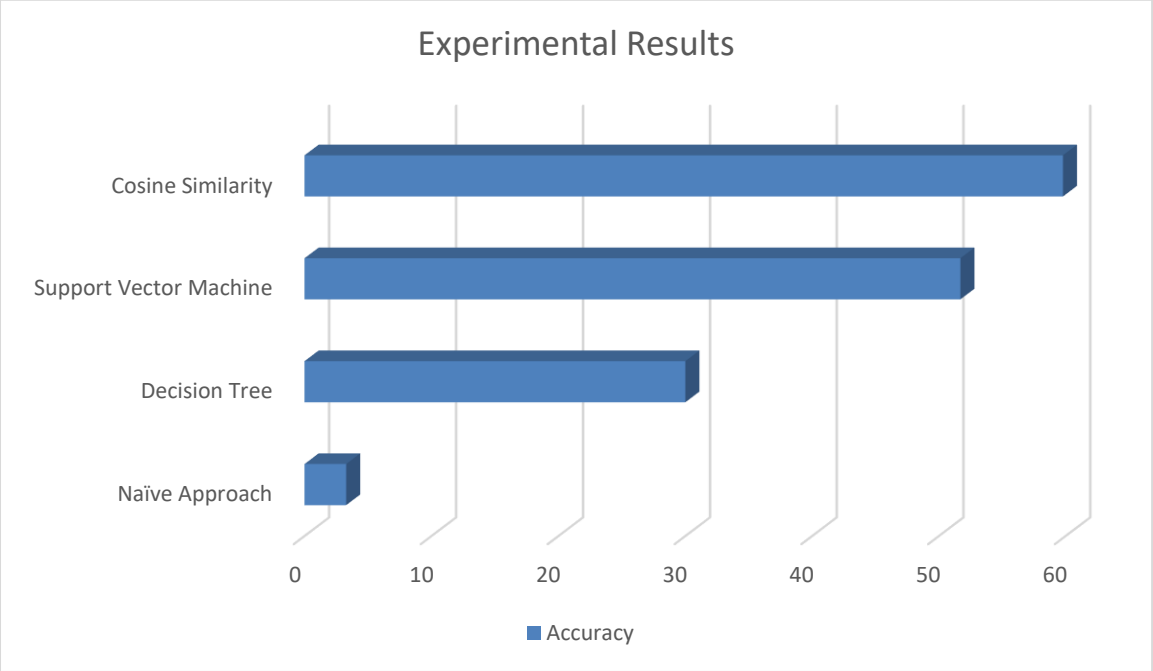

Figure 37: Experimental Results
This is the final results chart of the comparison between the recommendation system algorithms

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Chapter 6: Conclusion

The first part of our project involved deciding on the experimentation and testing of various algorithms to select the most suitable one. After that, we immediately started working on the implementation of the use cases of the project discussed in earlier sections of this document. We started off with the front-end development in React JS creating responsive web pages for user interactions. Then we created the backend models, serializers and restful APIs in Django Rest Framework to support and facilitate the front-end pages.

Some of the challenges faced involved figuring out the communication part between the front end and back end for fast, efficient communication as well as writing code which is maintainable and extensible. As a solution we found “axios”, a handy library for making communication between React JS and Restful APIs easier and easy to maintain.

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