

**TRIBHUVAN UNIVERSITY**  
**INSTITUTE OF SCIENCE AND TECHNOLOGY**



**Project Report on**

[REDACTED] : A web portal for Construction

In partial fulfillment of the requirements for the Bachelor's Degree in  
Computer Science and Information Technology

**Under the Supervision of**

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**Submitted to**

Tribhuvan University  
Institute of Science and Technology

**DATE: 1191991**

## **to Tribhuvan University**

## **SUPERVISOR'S RECOMMENDATION**

I hereby recommend that this project prepared under my supervision by

entitled "████████ - A web portal for Construction" in partial fulfillment of the requirement for the degree of BSc. in Computer Science and Information Technology (BSc. CSIT) be processed for evaluation.

Mr.

## Supervisor

Affiliated to Tribhuvan University

## CERTIFICATE OF APPROVAL

This is to certify that this project prepared by [REDACTED]

[REDACTED] - A web portal for Construction" in partial fulfillment of the requirements for the degree of BSc. CSIT has been well studied. In our opinion, it is satisfactory in the scope and quality of the required degree.

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## ACKNOWLEDGMENT

We have taken effort in this project. However, it would not have been possible without the help and support of many individuals and organizations. We would like to extend our sincere thanks to all of them.

We are highly thankful to [REDACTED] for providing us with this opportunity to showcase our learning through this project. We are also appreciative of the effort of our director for providing a learning environment contributing to the success of this project.

We would like to express our deepest sense of gratitude and sincere thanks to our highly respected supervisor [REDACTED] for his valuable guidance, encouragement and help. His useful suggestions for this project and cooperative behavior are sincerely acknowledged.

At the end, we would like to express our sincere thanks to all the friends and others who helped us directly or indirectly during this project work. This project has been a wonderful experience where we have learnt and experienced many beneficial things.

## ABSTRACT

The gathering of required products, equipment and other needs during the construction work is always a hectic process where a person has to spend days and hours to find needed materials. Even if they manage to find the product without many options to select, it becomes difficult to choose the right product in a short period of time. To reduce this laborious process, we have designed and implemented a recommendation system integrated in a construction web application. In this project, we contrast user-based filtering algorithms to recommend the product user might be interested in. The recommendation works based on the rating provided by the multiple users to a particular product and the algorithm used in the system will study & analyze the similarity and then predict the product to recommend based on the user rating. The system also provides the user to view, buy & order the product & related equipment.

This project aims to ease the hassle process for buying the construction materials. The primary objective of the project is to make construction materials & equipment easily accessible & available to the users just like any other ecommerce site. The system allows users to register and login into the system allowing them to view, search, rate, order the products that have been listed and displayed within a user-friendly interface.

**Keywords:** construction, recommendation, user-based filtering algorithms

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## LIST OF ABBREVIATIONS

ER	Entity Relationship
DFD	Data Flow Diagram
IEEE	Institute of Electrical and Electronics Engineers
B2B	Business to Business
B2C	Business to Consumer
COD	Cash on Delivery
UI	User Interface
GB	Gigabyte
SSD	Solid State Drive
SQL	Structured Query Language

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## Chapter 1: Introduction

### 1.1 Introduction

Development of software applications emerged post creation of the first digital computers, early applications that were built could only be used on standalone desktop machines or we can say local machines. Since the invention of the Internet in the late 90s, the computer network has become their standard way to communicate. Soon with the improvement in the quantity and quality of web content web sites, web applications started becoming more interactive and gradually their functionality evolved beyond static pages. Web application development received more significance when businesses established their presence in the online world. More browsers and development platforms unfolded as people started using the internet on a more regular basis. Web applications gained popularity as organizations and businesses started introducing applications that required the use of a web browser. With the arrival of the Internet, e-commerce started to bloom till date. E-Commerce websites are online portals that facilitate online transactions of goods and services through means of the transfer of information and funds over the Internet. In the early days, e-commerce was done partially through emails and phone calls. Now, with a single website, anything and everything that a transaction needs, can be executed online.

The project ‘Estatopedia’ is developed as a construction web-based application with the aim of providing a platform to the users who require related tools, equipment and machineries, etc. The system provides fundamental e-commerce functionalities along with recommendations features.

### 1.2 Problem Statement

Construction is a very vast sector. It includes various phases and various entities. The traditional way includes people searching for laborers, contractors, materials which may sometimes be very time consuming and costly. If this time for pre-arrangement can be cut-off, then it can be better utilized in the later phases to make the project more effective, stable and the project can be completed within the specified deadline. The goal is to develop such a system which allows users to compare and choose best rated materials.

In the conventional approach, the owner (user) manually searches for suppliers and products by self-visiting the construction site keeping track of all the expenses. Our proposed system aims to solve this problem by connecting all involved entities under a single application and allowing end users to choose the best out of the alternatives provided.

### **1.3 Objectives**

The objective of the project can be stated as:

- To build a recommendation system using User Based Collaborative Filtering Algorithm to recommend construction materials to the user based on their rated products.
- To build a web portal accompanying the recommendation system to make the process of buying the construction material more efficient.

### **1.4 Scope and Limitation**

#### **1.4.1 Scope**

The proposed system is to be developed in such a way that it benefits both the end-user and the different entities that are involved in the system. As a web-based system, the system will be easily accessible to those people with a device supporting a browser and an Internet connection.

Estatopedia as a system will allow users to view & search products, equipment with their respective information. Products from multiple suppliers are shown and users will be able to compare and select the product they desire manually. Estatopedia allows users to create an account that allows them to buy and rate products.

Estatopedia also allows registered users to get recommendations of related products based on their previous purchases and rating which will help them to find relevant products easily.

### 1.4.2 Limitations

The different limitations of this project are:

- Since the system is web based, it might not be accessible to people not having access to an Internet connection.
- The recommendation feature is limited to the registered users that means only the registered users get recommended products based on their interest and similarity.
- Since construction is such a vast field but the system is primarily focused on building construction, many users may not get what they wanted when they explore the application.

### 1.5 Development Methodology

Evolutionary prototyping is a software development method where the developer or development team first constructs a prototype. After receiving initial feedback from the customer, subsequent prototypes are produced, each with additional functionality or improvements, until the final product emerges. This prototyping scheme differs from the rapid or throwaway prototyping, in that the developer begins with the best understood requirements; whereas in rapid prototyping, the developer implements the least understood requirements. Furthermore, the first prototype need not be built quickly. Note that evolutionary prototyping is similar to incremental development in that parts of the system may be inspected or delivered to the customer throughout the software life cycle model. [1]

#### Stages of Evolutionary Prototyping

The different stages that are involved in Evolutionary Prototyping include:

1. Initial Requirement

In this phase, the requirements of the system are defined. Different methods can be used to gather the requirements of the system.

2. Prototyping Phase

It is the iterative phase which is repeated as per the requirement, it includes four sub-phases which include:

### i. Design & Development

In this phase, a simple design of the system is created which gives a brief idea about the system to the user. Based on the design, the prototype is developed, which is a small working model of the required system.

### ii. User Validation

In this phase, the developed prototype is verified and validated to make sure it meets the defined requirements of the system.

### iii. User Acceptance

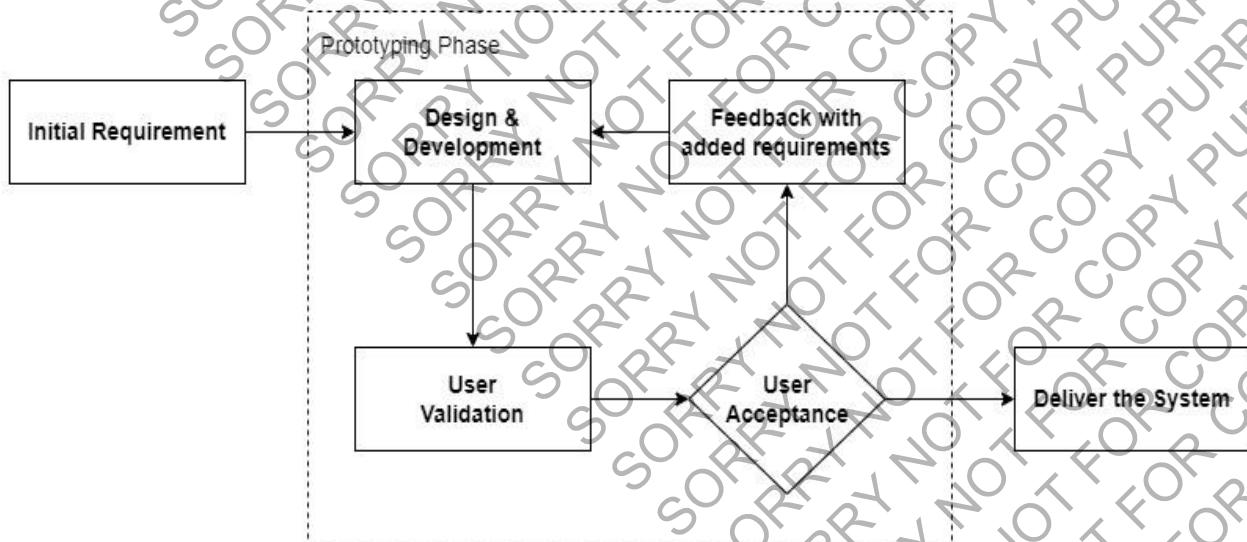
In this phase, the prototype is presented to the client for evaluation. If the user requirements are met, then the system is prepared for deployment otherwise the prototype is processed for further modification.

### iv. Feedback with added requirements

In this phase, comments and suggestions are collected from the client and provided to the developer with added requirements.

## 3. Deliver the system

Once the final system is developed based on the final prototype, it is thoroughly tested and deployed to production. The system should undergo routine maintenance for minimizing error or failures.



**Figure 1 Evolutionary Prototyping**

## **Reason for Selection of Evolutionary Prototyping as the development methodology**

Since the initial requirements of the system are predefined, the initial prototype of the system can be developed based on the requirements. Prototyping gives a clear idea about the different interfaces and components of the system before the complete system is developed. Different tests are conducted on the prototype to confirm the proper functioning. Then necessary changes can be made in the prototype in multiple iterations to finally deliver the intended system.

### **1.6 Report Organization**

The report has been prepared following the guidelines provided by Tribhuvan University. The report is separated into different chapters. Each chapter consists of various sub chapters with its content. The preliminary section of the report consists of Title Page, Acknowledgement, Abstract, Table of Contents, List of Abbreviations, List of Figures, and List of Tables.

The main report is divided into 6 chapters, which include:

#### **1. Chapter 1: Introduction**

It includes the general overview of the system and the project as a whole. It includes the Problem Statement, Objectives, Scope/Limitations and the Development Methodology for the project and the system being developed.

#### **2. Chapter 2: Background Study and Literature Review**

It includes the study of the current scenario/environment the system will be deployed into. It includes the study of the current trends, preferences of people, the existing systems, areas of improvement among others.

#### **3. Chapter 3: System Analysis**

It includes the requirement and feasibility analysis of the system that can be generated through the studies presented in the previous two chapters. It will also include the Flowchart, ER and DFD for the system which specifies the workflow, entities, attributes and their relationships.

#### 4. Chapter 4: System Design

It includes the design of the database, forms and interface of the system. It also includes the implementation details of the selected methodology and the details of the algorithm used.

#### 5. Chapter 5: Implementation and Testing

It includes the details of the different design and development tools used and the implementation details of the modules presented in the form of code snippets of functions, classes. It also includes the testing of the system with different test cases as per the requirement.

#### 6. Chapter 6: Conclusion and Future Recommendations

It includes the summary of the system and the project as a whole. It also includes the possibilities/aspects which the system can implement in the future.

The final part of the report consists of References and Appendices. The references are listed in accordance to the IEEE referencing standards and the Appendices includes the screenshots of the system and the major source code snippets.

## Chapter 2: Background Study and Literature Review

### 2.1 Background Study

Recommendation systems have gained importance in recent years, and appear very promising for e-commerce, especially in connection with Big Data. By working with large amounts of data and using sophisticated algorithms, we can increase the conversions of online stores with modern recommendation systems. In e-commerce, recommendation systems are already incorporated, but other sectors also benefit from continuously improving algorithms and technologies.

Recommendation services are always based on sets of data. Depending on the nature of this data set, a distinction is made between different types of systems. These are typically content-based and collaborative systems. Furthermore, there are also context-sensitive recommendation services, as well as those that include the chronological sequence or demographic user data in the analysis. The system that we are going to develop is a user-based collaborative filtering system. It is a technique used to predict the items that a user might like on the basis of ratings given to that item by the other users who have similar taste with that of the target user. Many websites use collaborative filtering for building their recommendation system. [2]

### 2.2 Literature Review

Building or Renovating a House is a time-consuming process and need lots of planning. One of the most tedious tasks in house construction is material procurement. There is lot of information you need before taking decision on building materials requirement for your house construction. [3]

For many retailers, e-commerce is a profitable, viable way of doing business. Yet in the building materials market, online sales account for just a small percentage of business. Part of this is down to the sheer size and volume of products in the building materials market; for some construction businesses, online retail logistics was simply not practical. Partly this comes from the traditional relationship, when craftsmen still pick up the goods for the day

or a few, in the morning from their building merchant. Perhaps in the past building materials and B2B e-commerce didn't go hand in hand, as many companies didn't know how to sell building materials online.

In a post-Covid world, businesses in all industries have turned to B2B e-commerce. Representatives in the building materials market may no longer be able to travel to construction sites as frequently as they once did. In addition, online shopping and online sales have become the norm. This trend has brought an accelerated acceptance of online equipment sales and purchases. [4]

In the context of Nepal, the e-commerce market is getting crowded day by day where smaller startups are trying to earn their place. With new e-commerce being established at a rapid phase, the total e-commerce market is estimated to worth more than 25 million which will easily triple in coming days. The future of e-commerce in Nepal is bright. Even the e-commerce giant Alibaba has made a large investment in one of the top e-commerce of Nepal i.e., Daraz. This itself proves that the market is going to get quite competitive in the coming days. [5] In the sector of ecommerce for construction materials there are a few existing systems which are providing the facility of buying construction materials online for the customers which include Hamro Nirman, Gharbanau, Nepal Construction Mart, etc. These systems have their own set of good features and there are also room for improvement. None of these systems have the recommendation feature which is one of the important parts of any ecommerce-based systems.

Our aim is to develop a system in such a way that it incorporates the good features from these systems with an addition of the feature of recommendation. The recommendation feature will allow the registered user in our system to receive recommendation based on their purchases and the rating they provided making it easier to access the necessary products within the system.

## **Study of Existing System**

### **1. Gharbanau**

Gharbanau provides services to those who want to buy or sell construction materials. It is an online marketplace for those who want to buy construction materials at a reasonable price in Nepal. It is a platform where buyers and sellers can deal with the construction materials directly with each other. Gharbanau is simply a bridge between the buyers and the sellers. [6]

#### **Good Features:**

- Categorization of products based on product type, brands, supplier, etc.
- Provides delivery for products with COD option and customer support

#### **Lacking Features:**

- Option to rate products
- Option to compare products

### **2. Hamro Nirman**

Hamro Nirman is the first mover as well as largest e-commerce in Construction field where it provides the largest B2B as well as B2C marketplaces in Nepal. It's the only platform which provides all Construction related solutions under one roof such as hardware, electrical, sanitary, plumbing, machinery and building materials via web portal in Nepal.

[7]

#### **Good Features:**

- Provides a section for New Arrivals, Best Selling products
- Can filter the products based on different criteria

#### **Lacking Features:**

- Could include recommendations based on rating provided

### 3. Nepal Construction Mart

Nepal Construction Mart is the 1st online store established for providing complete solution of construction and building materials for household and commercial constructions registered under Value properties Pvt. Ltd. They provide the complete e-commerce solutions to construction materials and services that give priorities to quality and customer satisfaction and on time delivery. [8]

#### **Good Features:**

- Lists products that are Featured and on Sale
- Option for Return and Cancellation

#### **Lacking Features:**

- It doesn't list the supplier for the product
- No option to filter product based on price, availability, etc.

## Chapter 3: System Analysis

### 3.1 System Analysis

#### 3.1.1 Requirement Analysis

##### i. Functional Requirements

###### **End-user (Customer)**

- Rate the products
- View/Compare the products
- Create and edit their own profile
- Search for products
- Create/Track orders
- View Recommendations provided

###### **Admin**

An admin should be able to perform the following activities within the system:

- Create and edit their profiles
- List the products
- Add/Update/Remove category/subcategory
- Add/Update/Remove products available
- View the customer (end-users) details
- View/Maintain orders

Our system allows two user privileges, one is the admin and the other is the customer. The different activities that can be performed by the users in our system have been mentioned in the points above. And, the Use Case diagram below presents the same in a graphical format.

### Use Case Diagram

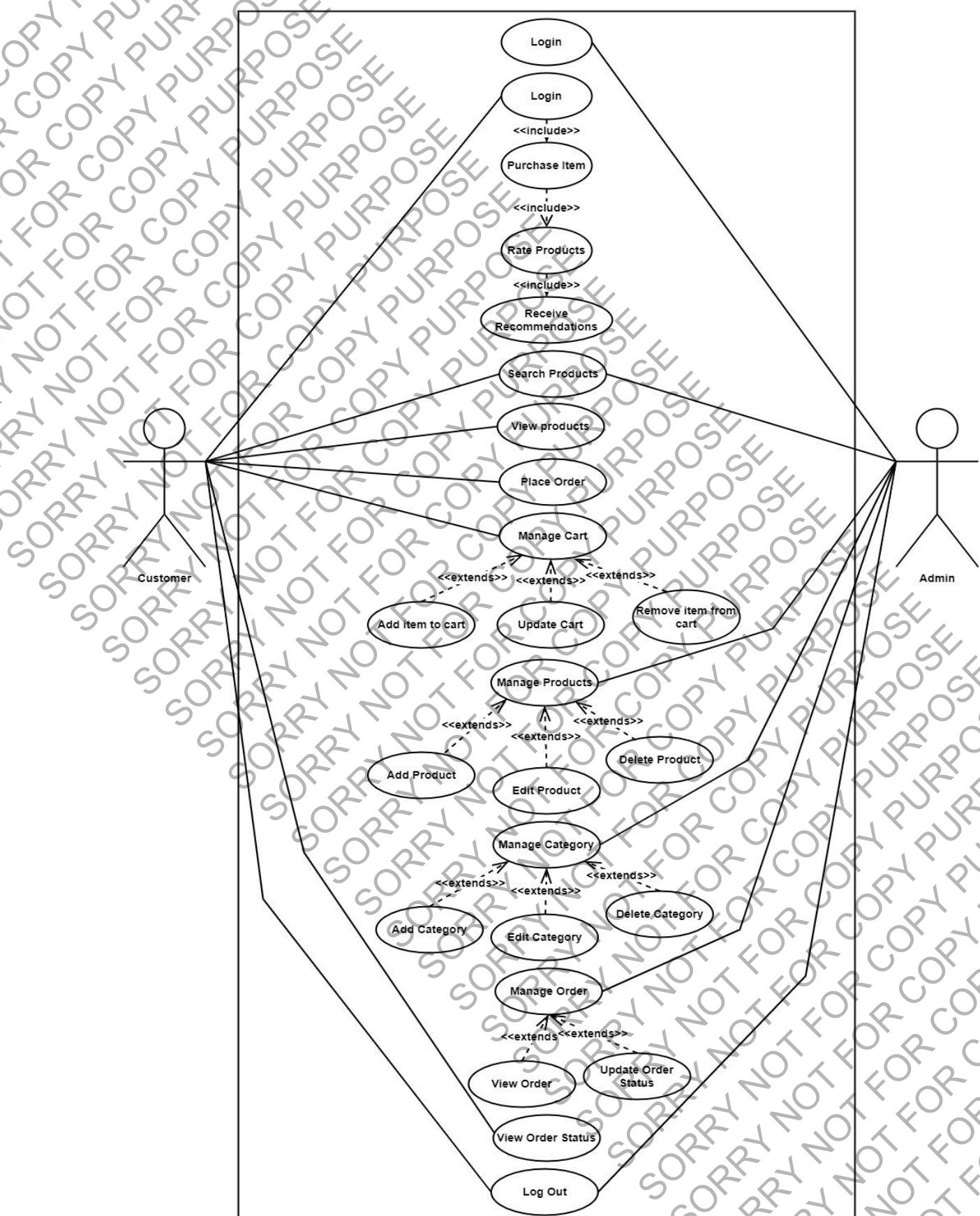


Figure 2 Use Case Diagram

## **Hardware Requirement**

The hardware requirement for the project includes a laptop with support for HTML5, CSS, and other Implementation tools required for the project. The minimum system requirements for the laptop include: i5 11<sup>th</sup> Gen., 16 GB Ram, 512 SSD, Windows 11 Professional.

As the final goal of the system is to be hosted and be accessible by anyone, we have studied a few hosting providers which include Gurkha.Host, World Link, Web Host with average cost ranging from as low as Rs. 10.00 to as high as Rs.65,000.00 with its own set of features provided accordingly which will be implemented in the future.

## **Software Requirement**

The software requirements for the project include implementation tools like Visual Studio Code, Figma, SQL Server, all of which are open-source programs so can be utilized in the project without any additional costs.

Lucidchart and Diagrams.net are to be used to prepare the necessary diagrams for the project, both of which are open source so no additional cost is required.

### **ii. Non-Functional Requirements**

- **User Friendly:** Estatopedia is user friendly, visitors or users don't require a high level of knowledge and computer skills to access the web application. Estaopedia uses simplified and basic design, navigation and UI to improve the user experience.
- **Easy Access:** Estatopedia is an ecommerce web application for construction purposes, it can be easily accessed anywhere with a good internet connection.
- **Responsive design:** Estatopedia uses Bootstrap, with its responsive design the users can get easy access to the web application from anywhere with any devices, this can improve the user experience of remote areas where people have limited access to computers.
- **Security & Privacy:** The system highly focuses on the user's privacy privilege. Estatopedia integrates secure payment gateway so that it maintains user's security & privacy status.
- **Performance Speed & Accuracy:** The system will run smoothly as long as the system configuration supports the minimum requirements and the stable internet connection.

### 3.1.2 Feasibility Analysis

A feasibility study, also known as feasibility analysis, is an analysis of the viability of an idea. It describes a preliminary study undertaken to determine and document a project's viability. The results of this analysis are used in making the decision whether to proceed with the project or not. In short, a feasibility analysis evaluates the project's potential for success, following feasibility analysis was performed prior to working on the project:

#### 1. Technical

The Web application is technically feasible; complies with current technology, including both the hardware and the software. The Web application is supported by almost all the latest web browsers, and most of all, it can run on any modern operating system.

Hence, the proposed system is technically feasible.

#### 2. Operational

- The proposed system will meet the requirements of the customers as well as clients when it is developed and installed, and there is sufficient support from the users.
- The proposed system will improve the total performance.
- Customers here are the most important part of the system and the proposed system will provide them with a convenient mode of operation for them.
- The proposed system will be available for the customers for working online throughout the globe.

Hence, the proposed system is operationally feasible.

#### 3. Economic

- Minimum equipment is required to develop the system. No one is required to maintain the system. The member who wants to work through the system will manage the products, profiles, etc. themselves.
- However, the developer of the system can earn money by taking minimum fees from the member who wants to use the system.

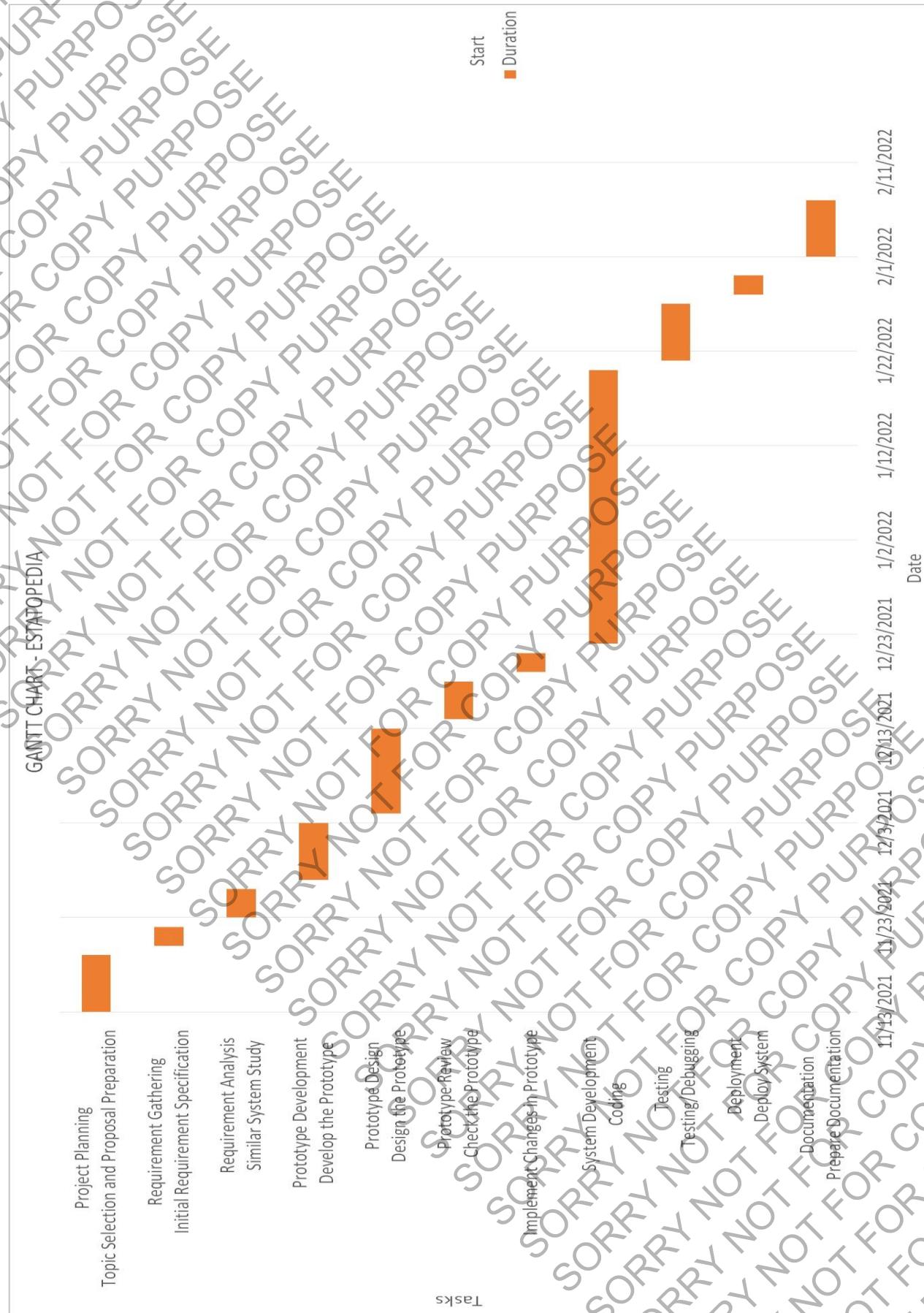
Hence, we can conclude that the proposed system is economically feasible.

#### 4. Schedule (Gantt Chart)

The project expands over a period of 75 days with Task being divided along with duration in the time frame. In order for the system to be delivered in the specified time frame we have to make sure deadlines are met and tasks are executed accordingly in the specified duration period.

**Table 1 Gantt Chart**

Task	Stages	Start	Finish	Duration
<b>Topic Selection and Proposal Preparation</b>	<b>Project Planning</b>	<b>11/13/2021</b>	<b>11/19/2021</b>	<b>6</b>
<b>Initial Requirement Specification</b>	<b>Requirement Gathering</b>	<b>11/20/2021</b>	<b>11/22/2021</b>	<b>2</b>
<b>Similar System Study</b>	<b>Requirement Analysis</b>	<b>11/23/2021</b>	<b>11/26/2021</b>	<b>3</b>
<b>Develop the Prototype</b>	<b>Prototype Development</b>	<b>11/27/2021</b>	<b>12/3/2021</b>	<b>6</b>
<b>Design the Prototype</b>	<b>Prototype Design</b>	<b>12/4/2021</b>	<b>12/13/2021</b>	<b>9</b>
<b>Check the Prototype</b>	<b>Prototype Review</b>	<b>12/14/2021</b>	<b>12/18/2021</b>	<b>4</b>
<b>Implement Changes in Prototype</b>		<b>12/19/2021</b>	<b>12/21/2021</b>	<b>2</b>
<b>Coding</b>	<b>System Development</b>	<b>12/22/2021</b>	<b>1/20/2022</b>	<b>29</b>
<b>Testing/Debugging</b>	<b>Testing</b>	<b>1/21/2022</b>	<b>1/27/2022</b>	<b>6</b>
<b>Deploy System</b>	<b>Deployment</b>	<b>1/28/2022</b>	<b>1/30/2022</b>	<b>2</b>
<b>Prepare Documentation</b>	<b>Documentation</b>	<b>2/1/2022</b>	<b>2/7/2022</b>	<b>6</b>

**Figure 3 Gantt Chart**

### 3.1.3 Analysis

- Flowchart

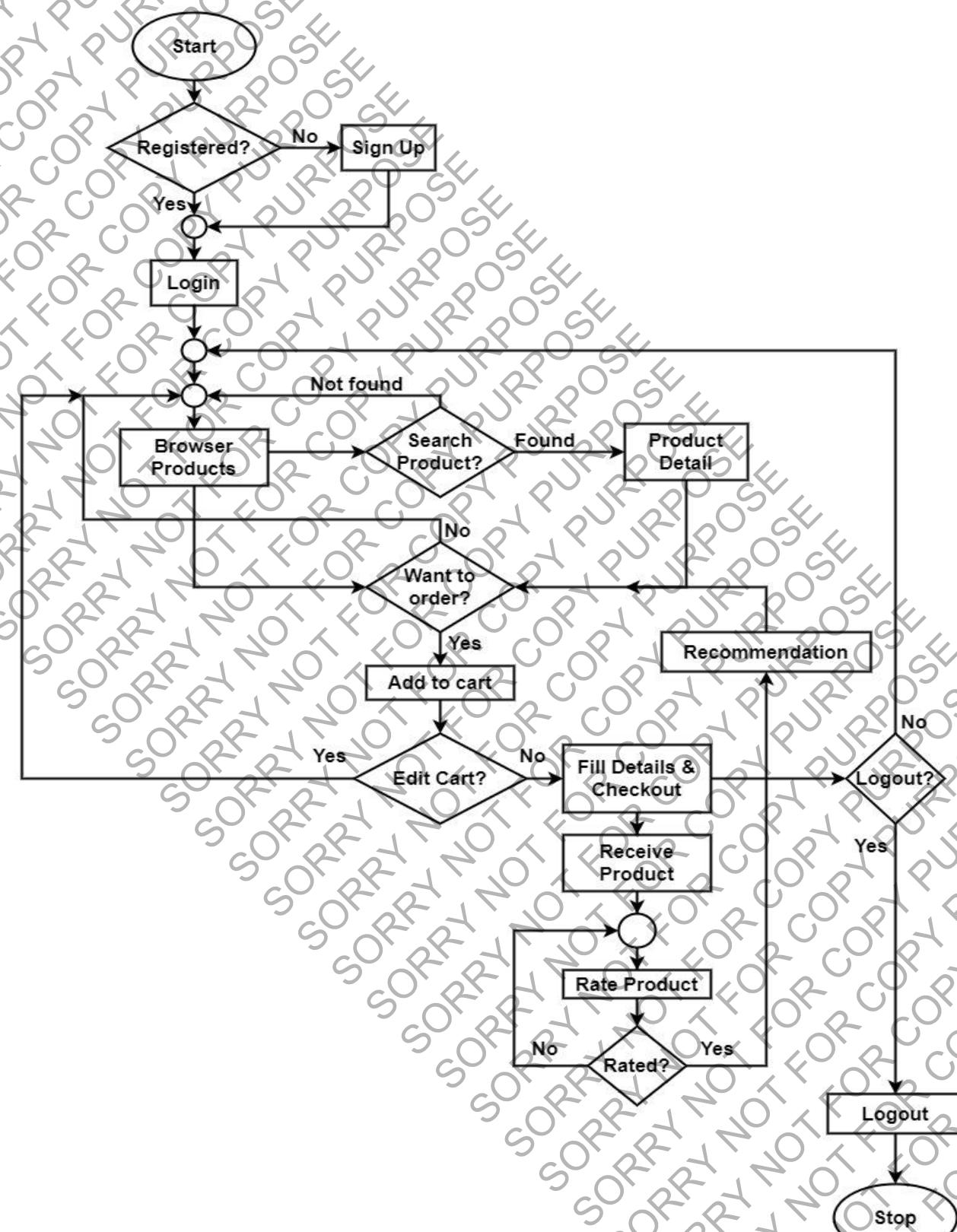


Figure 4 Flowchart for Customer

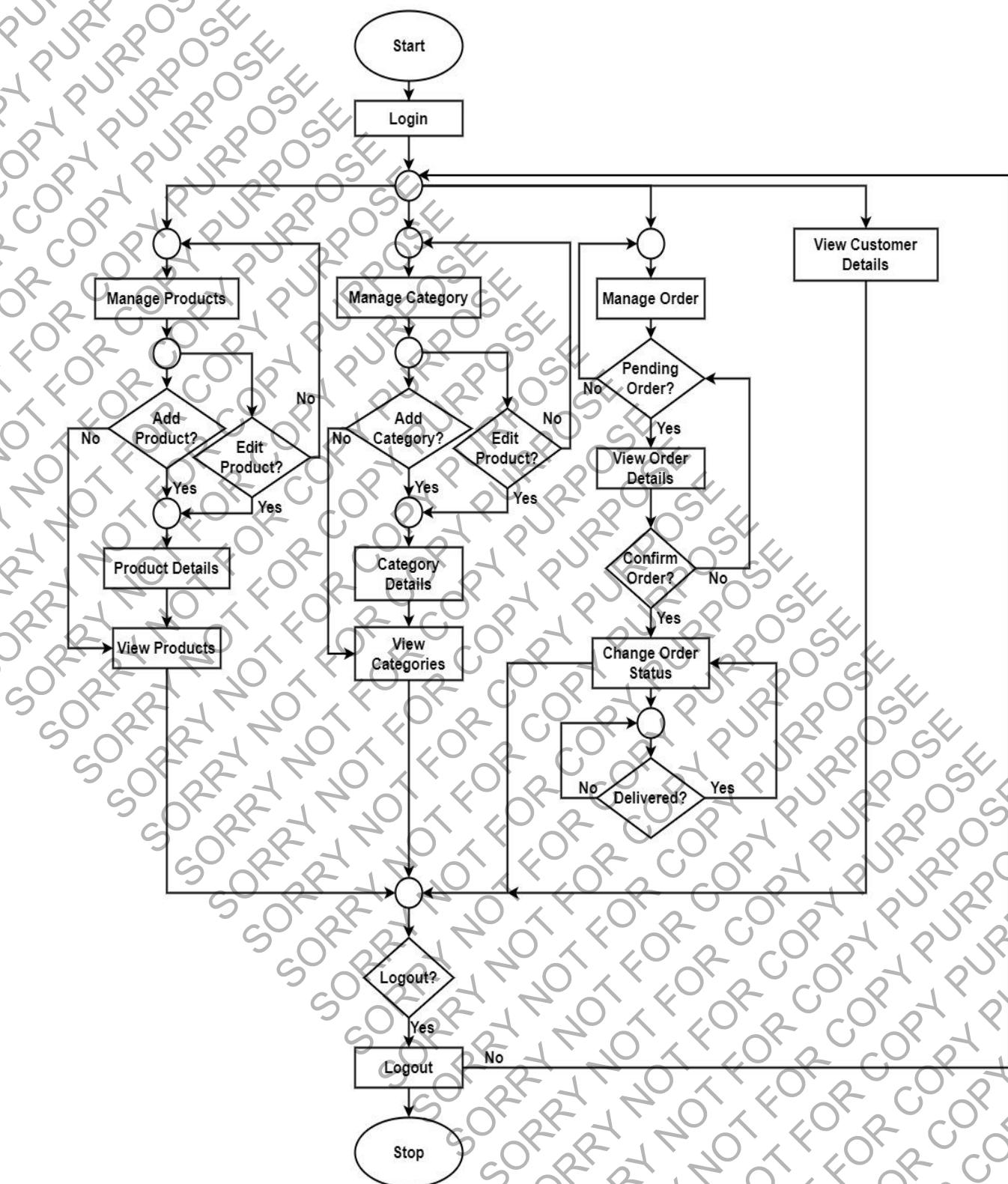
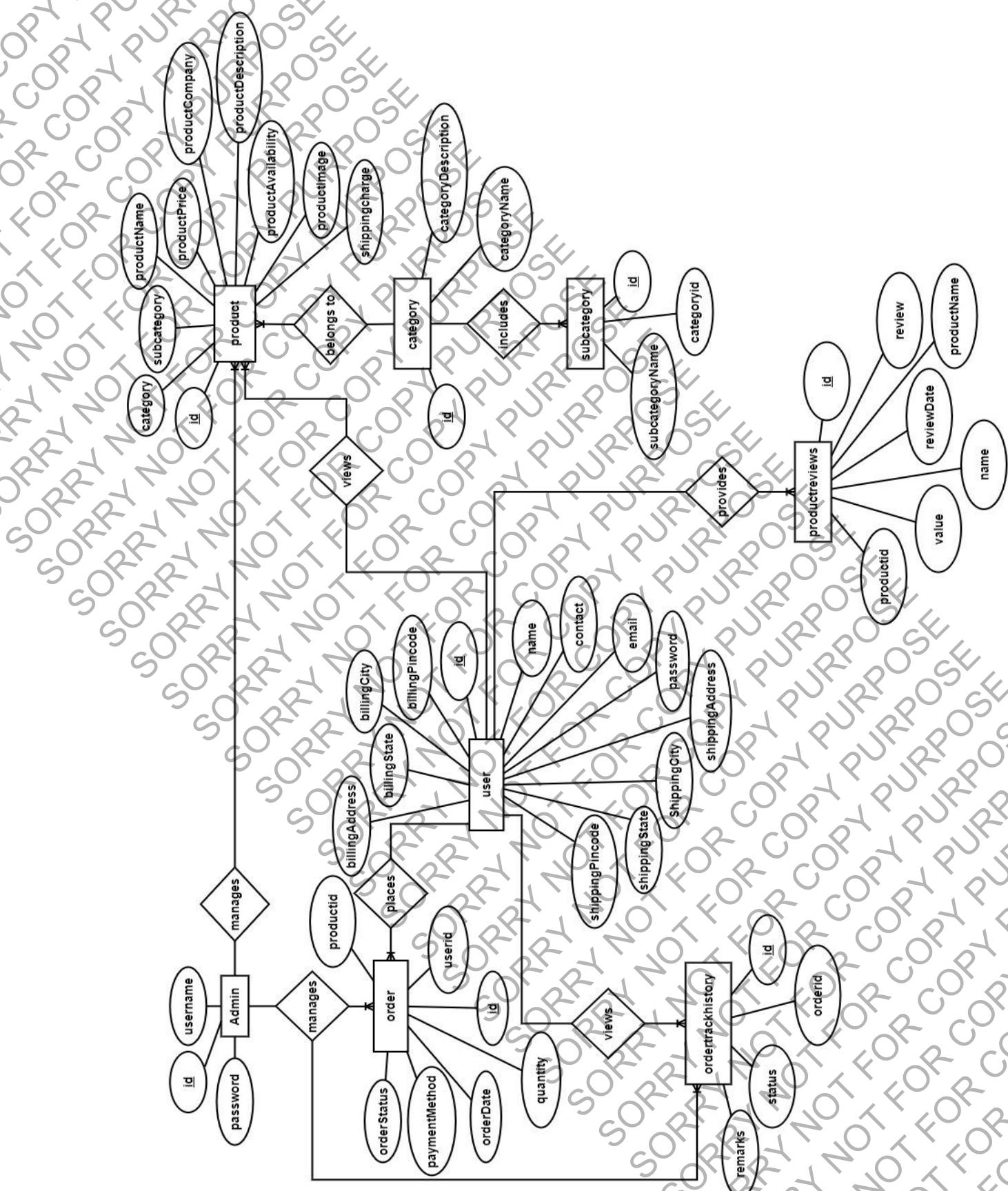


Figure 5 Flowchart for Admin

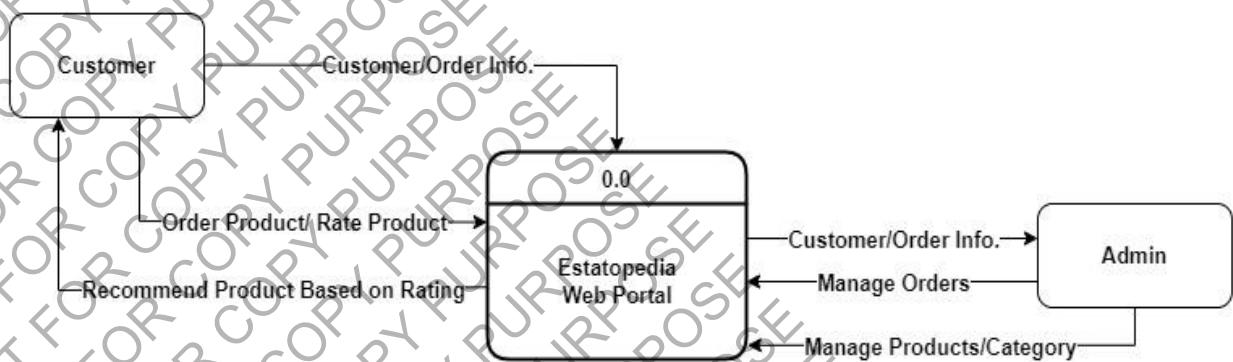
• **ER Diagram**



**Figure 6 ER Diagram**

- **DFD**

The context level data flow diagram describes the whole system. The 0 Level DFD describes all user modules who operate the system. The Below DFD of the system (Estatopedia) shows the two users can operate the system, Customer and Admin.



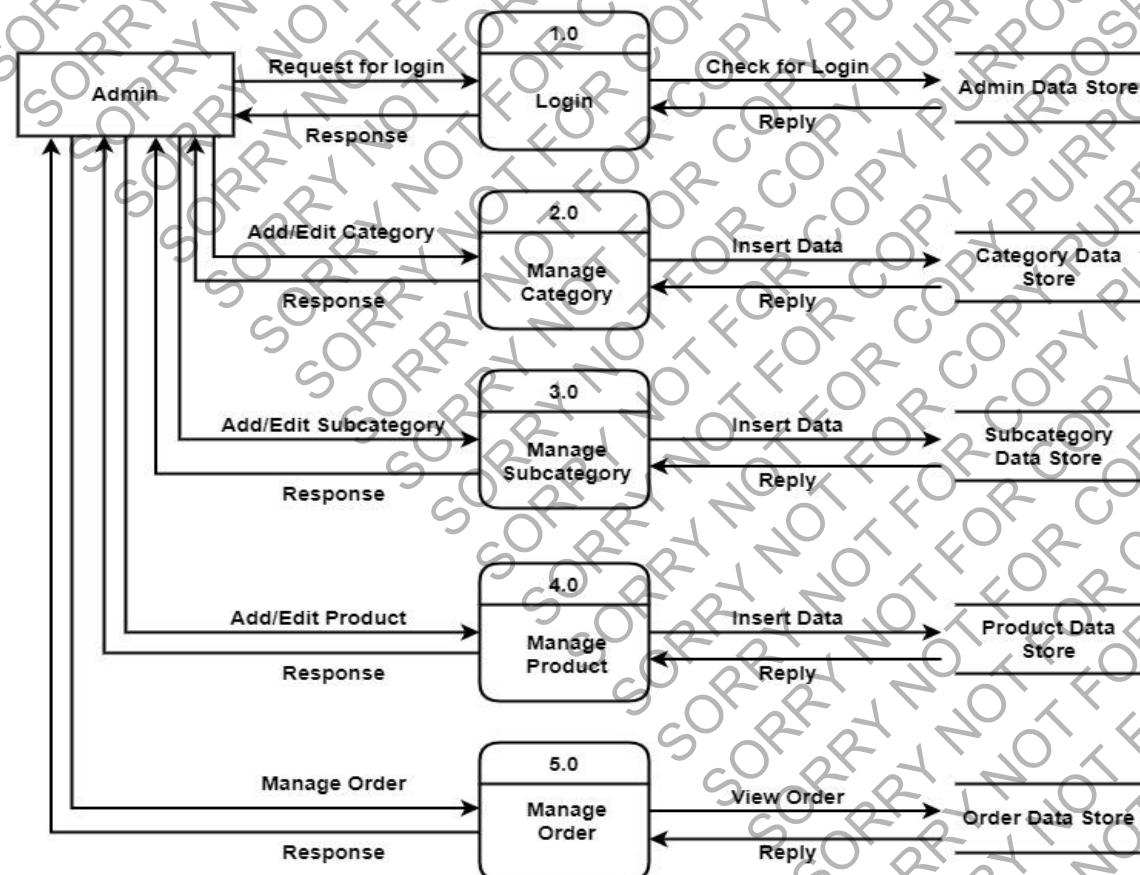
**Figure 7 DFD Level 0**

#### DFD Level 1 for Admin

The DFD for Admin describe the functionality of Admin, Admin is the owner of the system.

Admin can add category, subcategory for a product and then add products accordingly.

Then the admin can manage the order.



**Figure 8 DFD Level 1 for Admin**

### DFD Level 1 for Customer

Customer include all people who operate or visit our website. The Customer can register in our system and then login. After that they can search for product, select product to buy, place an order from our website. The customer can then rate the purchased product and then view the recommendation generated accordingly.

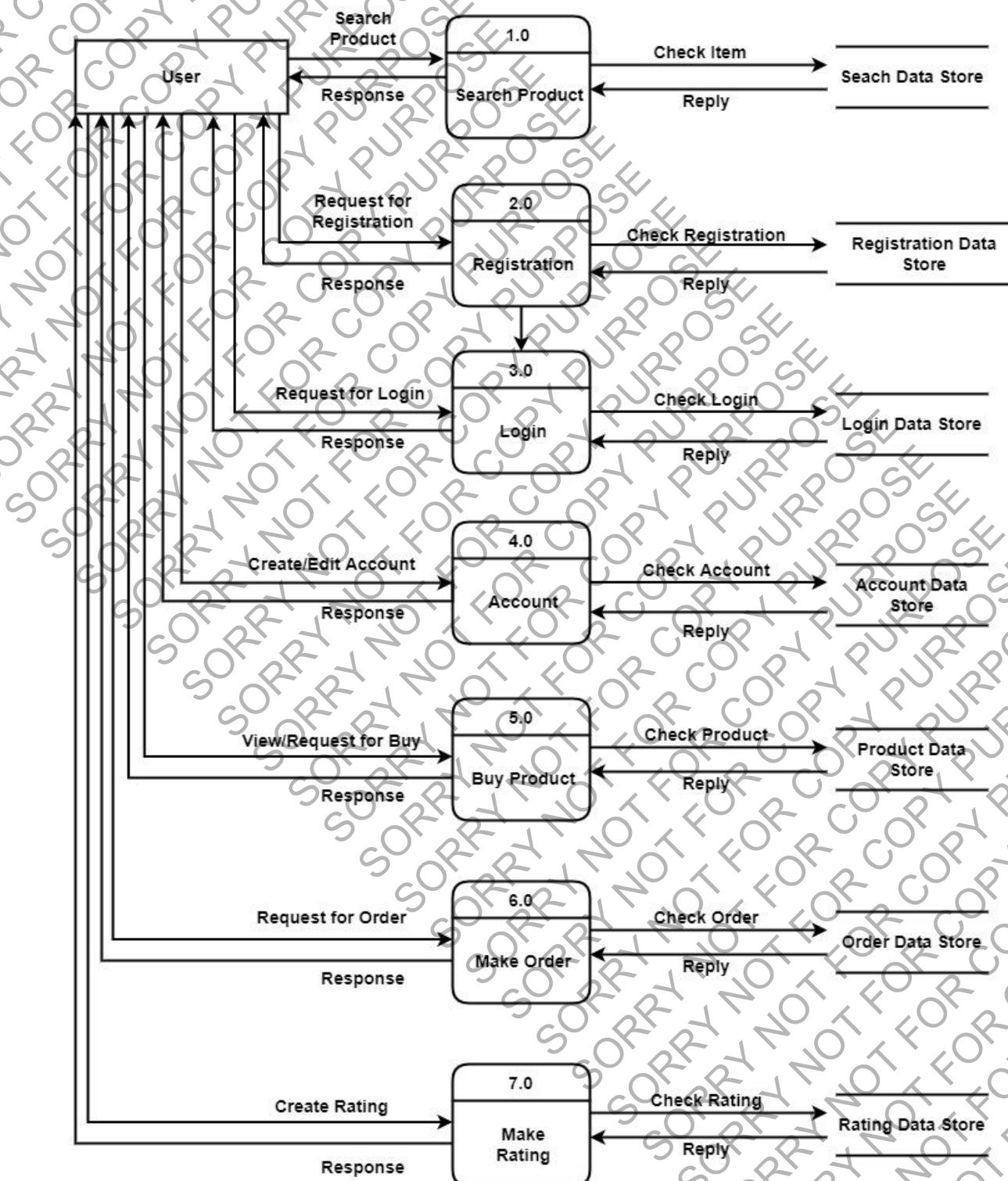


Figure 9 DFD Level 1 for Customer

## Chapter 4: System Design

### 4.1 Design

- Database Design



Figure 10 Database Design

- **Form Design**

Forms are an important part of a system as they are used to get data from the users. The different forms that will be required for the system include:

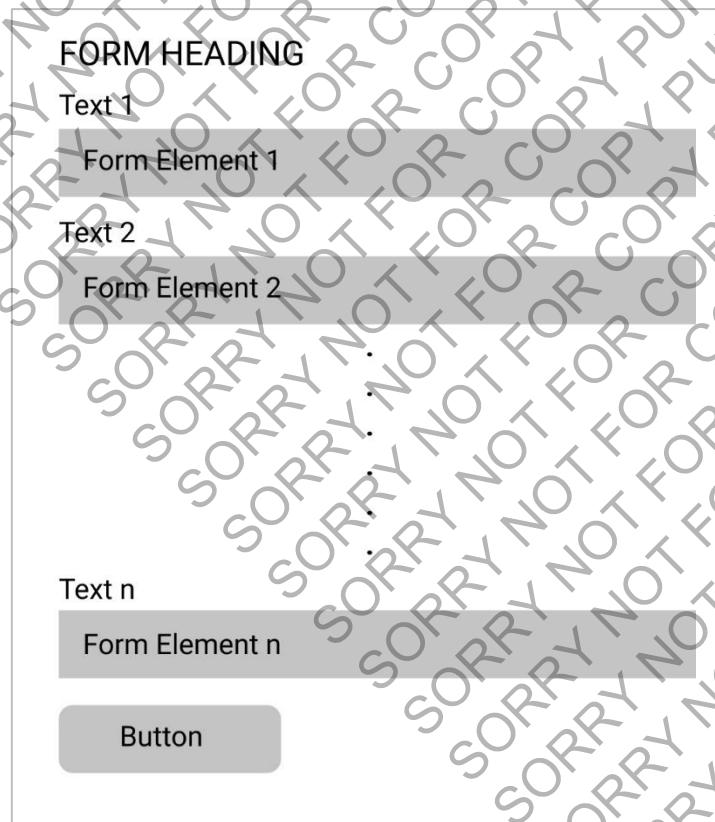
- **In the customer side**

1. Form for Login & Sign Up
2. Form for Updating profile/password information
3. Form for Adding/Updating of Billing/Shipping information

- **In the admin side**

1. Form for Login
2. Form for Updating password
3. Form for Adding/Updating
  - a. Product
  - b. Category
  - c. Sub Category

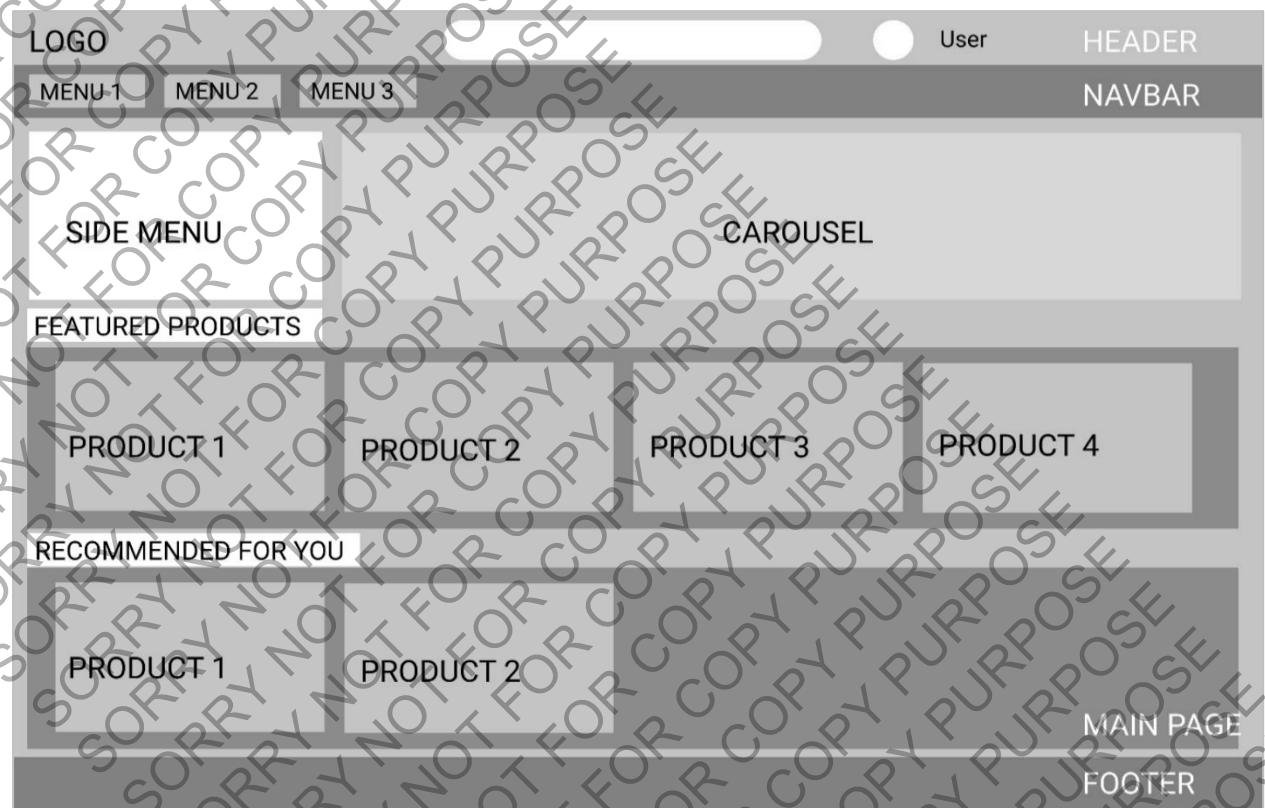
The forms will be created using different elements of the `<form>...</form>` tag as per requirement and using JavaScript for the Validation purpose.



**Figure 11 Basic Layout of Forms**

- **Interface Design**

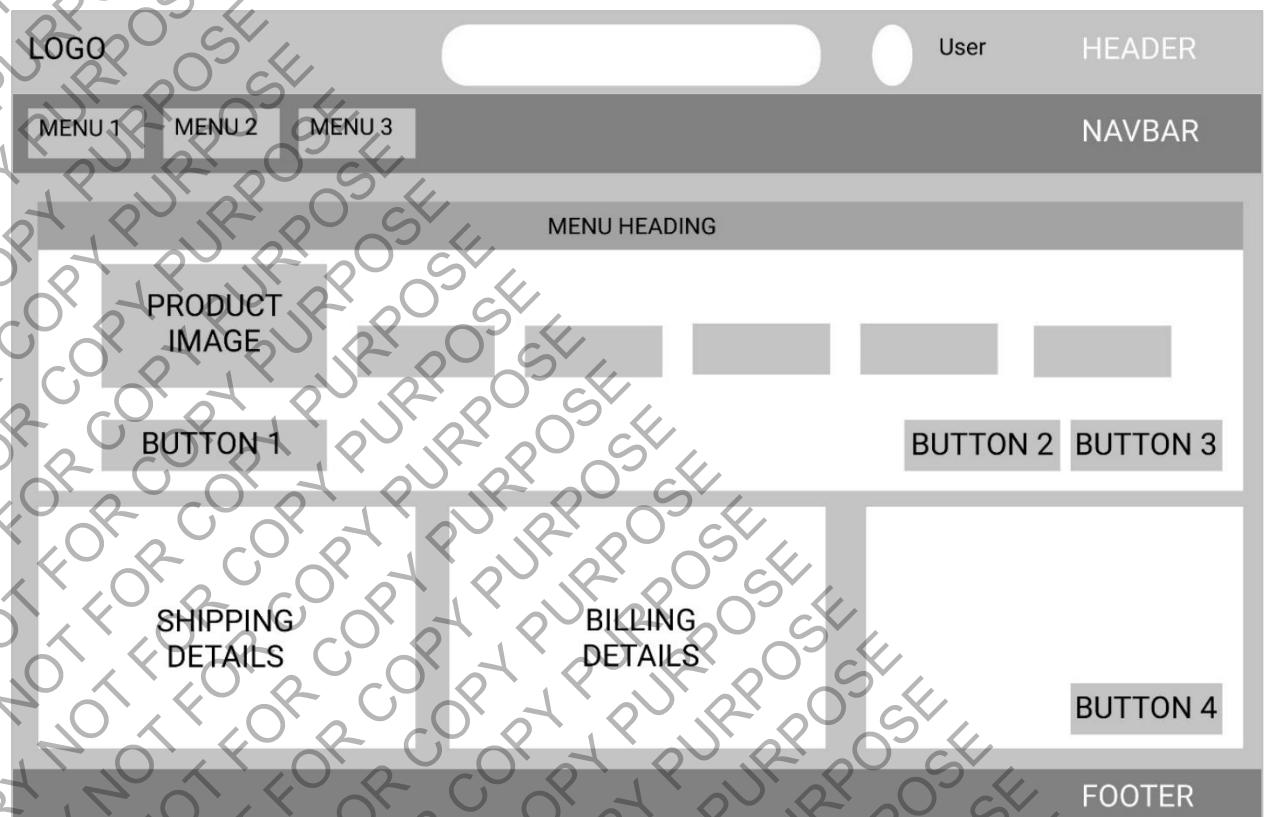
UI/Interface is one of the most important parts of the system as it determines how easy it is for a new user using the system to understand the different components listed and navigate through them in order to achieve the intended goal of using the system. The interface of our system will be presented according to the following representations:



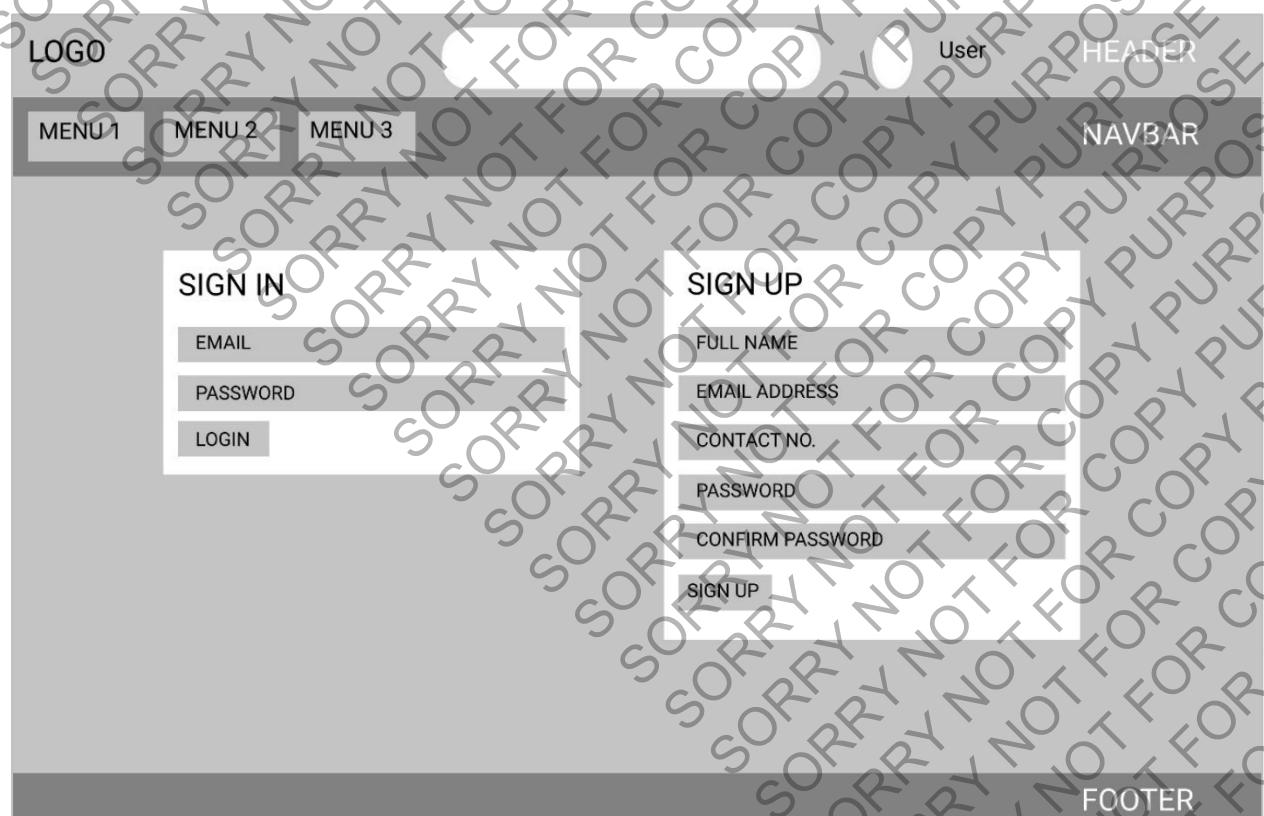
**Figure 12 Interface for Homepage**



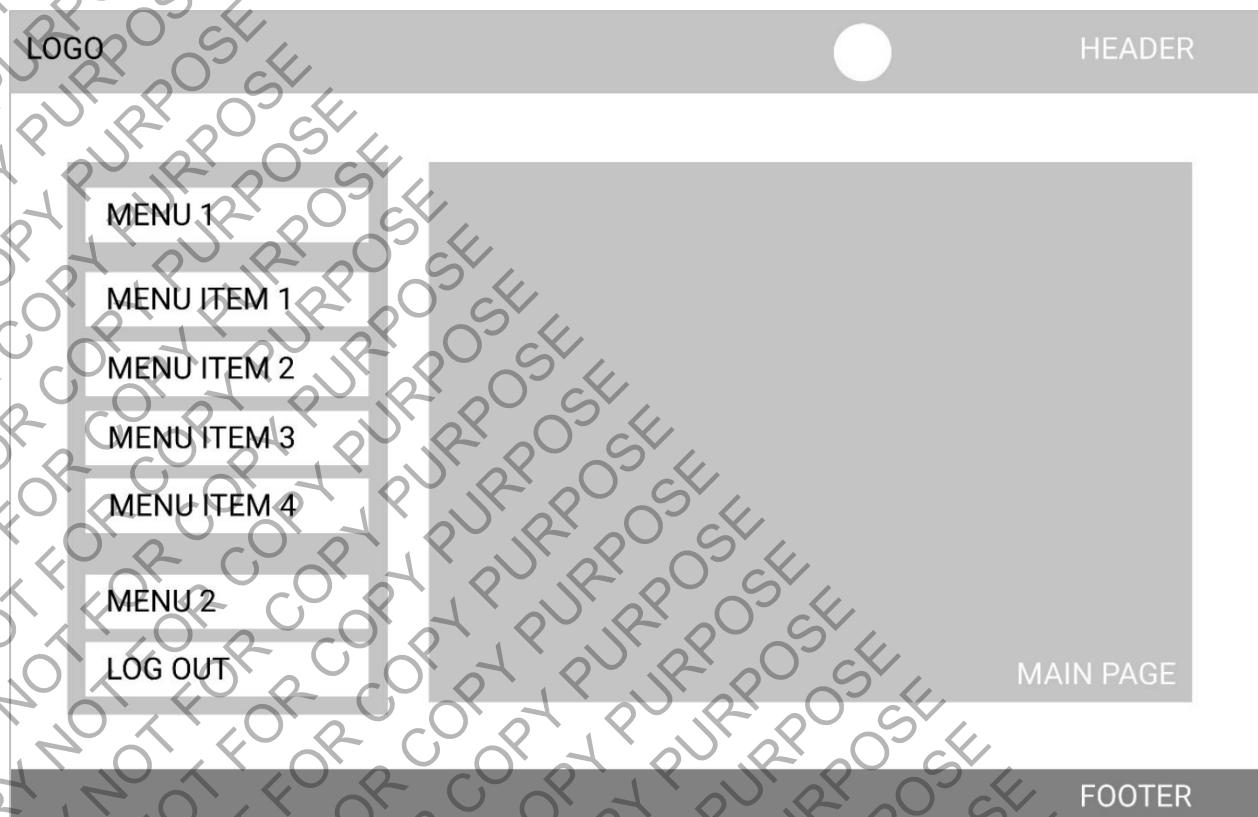
**Figure 13 Interface of Login for Admin**



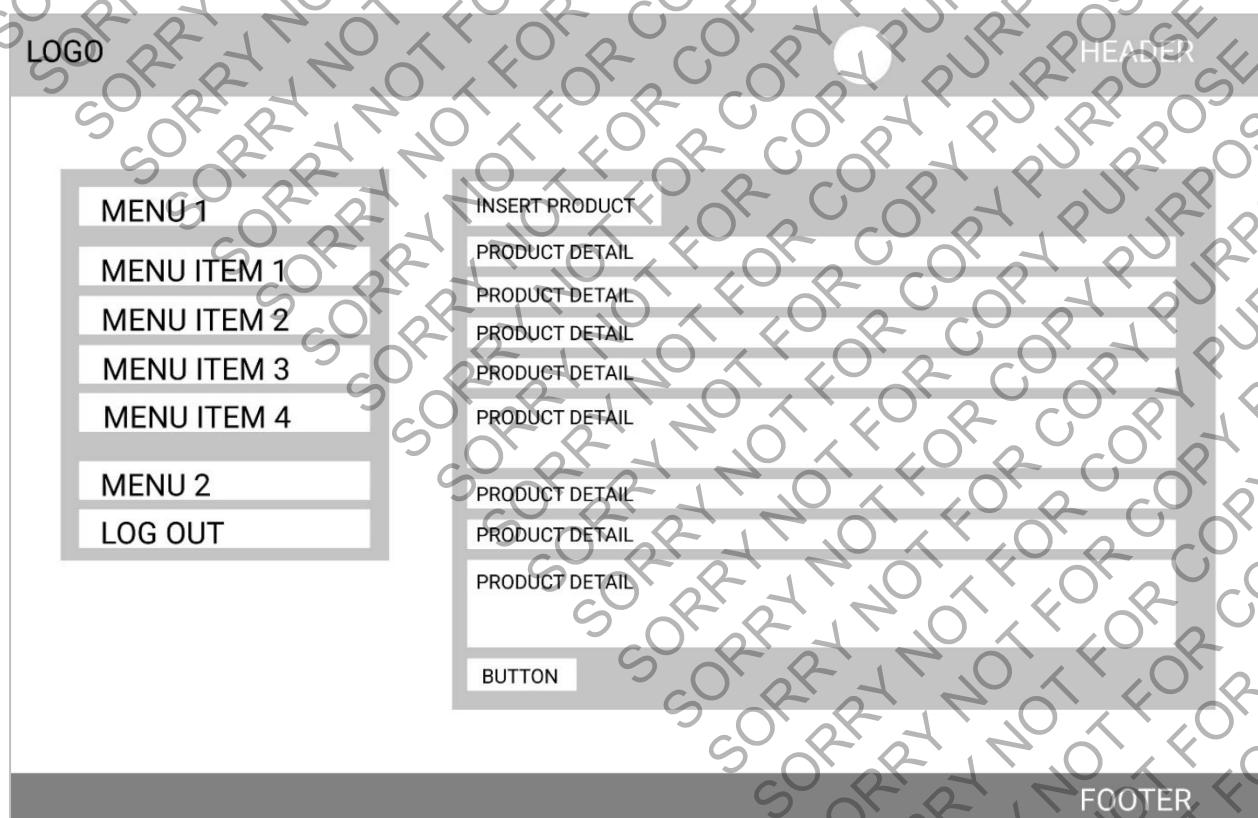
**Figure 14** Interface for My Cart



**Figure 15** Interface of Login/Sign Up for Customer



**Figure 16 Interface for Admin Dashboard**

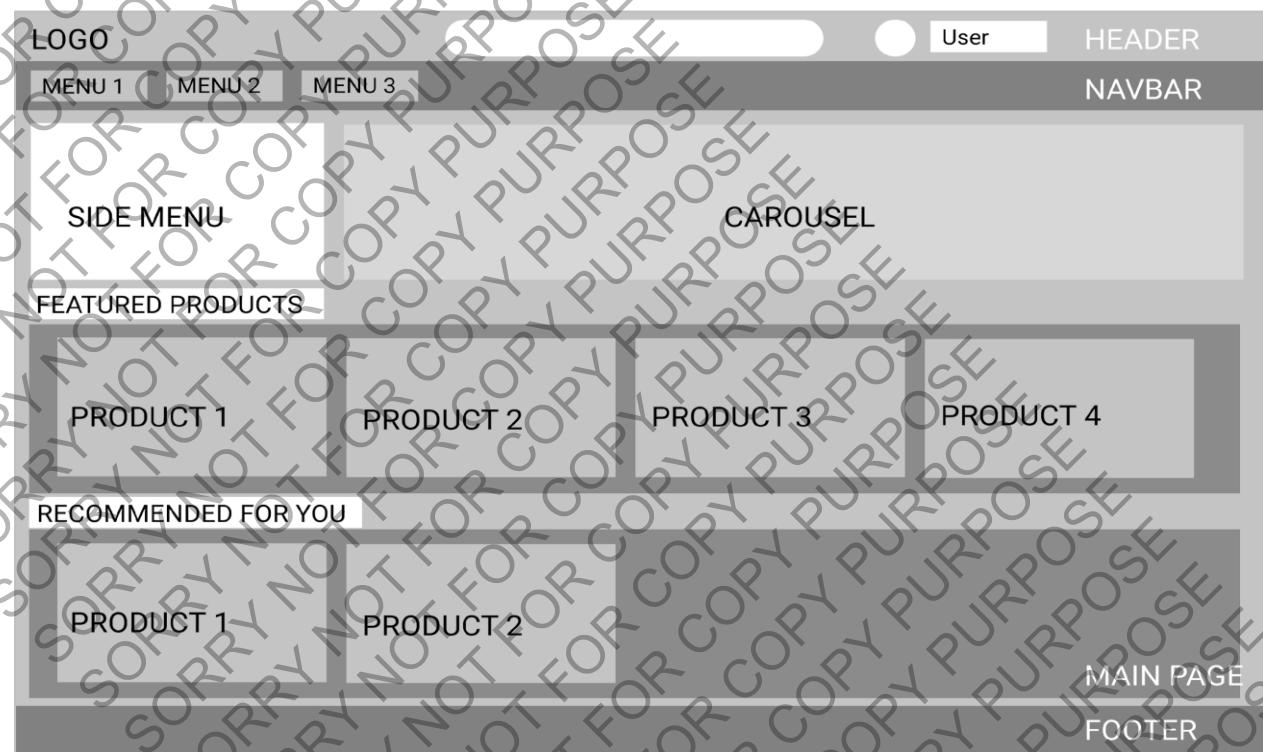


**Figure 17 Interface for Product Adding/Updating**

## Implementation of Evolutionary Prototyping

The system is developed using the stages of evolutionary prototyping. With the initial requirements in place to develop a user-friendly interface with clear definition of the entity and relationship of the system through requirement identification and analysis, the initial prototype for the system was laid out.

**Prototype 1**



**Figure 18 Prototype 1**

The above prepared prototype presents how the different components are to be arranged in the UI of the system. The Header section will include a logo, a search bar and user settings. The Navbar section will include the different menus included in the system. The Main Page will include a side menu and a carousel at the top, a set of featured products in the next and the set of recommended products in the following part. The final section will include the Footer section that will include the copyright and other necessary information about the system.

## Prototype 2

After finalizing the prototype for the basic UI of the system, an interactive prototype was designed using Figma to get a clear idea of the different web pages that needed to be developed within the system in order to achieve the intended goal. Some of the screenshots for the prototype developed using Figma are as follows:



**Figure 19 Prototype 2**

The above prototype shows the different sections that were finalized during the first phase of prototyping in a visually appealing manner. We can clearly see the different sections and the components that are to be included within the section.



**Figure 20 Prototype 2**

The above prototype shows the Profile interface for the user in which we can see the profile information with a button to edit the details, log out button, the logo and user information.

## 4.2 Algorithm Details

### **Collaborative filtering**

Collaborative filtering (CF) is a technique used by recommender systems. Collaborative filtering is the process of filtering for information or patterns using techniques involving collaboration among multiple agents, viewpoints, data sources, etc. Application of Collaborative filtering methods typically involves very large data sets. Collaborative filtering has been applied to many different kinds of data including: sensing and monitoring data, such as in mineral exploration, environment sensing; financial data; or in electronic commerce and web application where the focus is on user data, etc. [9]

### **User Based Collaborative Filtering**

User-Based Collaborative Filtering is a technique used to predict the items that a user might like on the basis of ratings given to that item by the other users who have similar taste with that of the target user. Many websites use collaborative filtering for building their recommendation system. [10]

### **Overview of User Based Collaborative Filtering**

The goal of a collaborative filtering algorithm is to suggest new items or to predict the utility of a certain item for a particular user based on the user's previous likings and the opinions of other like-minded users. In a typical CF scenario, there is a list of m users  $U = \{u_1, u_2, \dots, u_m\}$  and a list of n items  $I = \{i_1, i_2, \dots, i_n\}$ . Each user  $u_i$  has a list of items  $I_{ui}$ , which the user has expressed his/her opinions about. Opinions can be explicitly given by the user as a rating score, generally within a certain numerical scale, or can be implicitly derived from purchase records, by analyzing timing logs, by mining web hyperlinks and so on. Note that  $I_{ui} \subseteq I$  and it is possible for  $I_{ui}$  to be a null-set. There exists a distinguished user  $u_a \in U$  called the active user for whom the task of a collaborative filtering algorithm is to find an item likeness that can be of two forms.

- Prediction is a numerical value,  $P_{a,j}$ , expressing the predicted likeliness of item  $i_j \notin I_{ua}$  for the active user  $u_a$ . This predicted value is within the same scale (e.g., from 1 to 5) as the opinion values provided by  $u_a$ .

- Recommendation is a list of N items,  $I_r \subset I$ , that the active user will like the most.

Note that the recommended list must be on items not already purchased by the active user, i.e.,  $I_r \cap I_{ua} = \emptyset$ . This interface of CF algorithms is also known as Top-N recommendation. [11]

### Method

Calculation of similarity using Euclidean Distance

**Table 2 Sample Data**

Product/ Customer	Bricks	Cement	Pipes	Steel	Sand	Wood
John	4.5	3.5	4	4		
Martha		2.5	4.5		5	3.5
Mathew	3.75		4.25	3		3.5
Nick	4	3		4.5	4.5	

For the above example, we have 4 users (John, Martha, Mathew and Nick) who have provided ratings for a set of products (Bricks, Cement, Pipes, Steel, Sand and Woods) ranging from 0 to 5, with 5 being the best and 0 being the worst. Now, if we want to calculate the similarity between users John and Mathew it can be done by calculating the Euclidean Distance between the ratings, they have provided corresponding to the same items. Here, for the users we have common products Bricks, Pipes and Steel. Consider the rating corresponding to each product to be the distance elements.

### Euclidean Distance Theory

$$\sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

This formula helps in calculating the Euclidean Distance, where n is the total number of elements, x and y are the two distance elements. [12]

In the above example, total elements n = 3

For each similar element

i) For Bricks

Value of x corresponds to the ratings of Bricks of John and value of y corresponds to the ratings of Bricks of Mathew.

So, using formula  $(x_i - y_i)^2$  we get  $(4.5 - 3.75)^2 = 0.5625$

### ii) For Pipes

Value of x corresponds to the ratings of Pipes of John and value of y corresponds to the ratings of Pipes of Mathew.

So, using formula  $(x_i - y_i)^2$  we get  $(4 - 4.25)^2 = 0.0625$

### iii) For Steel

Value of x corresponds to the ratings of Steel of John and value of y corresponds to the ratings of Steel of Mathew.

So, using formula  $(x_i - y_i)^2$  we get  $(4 - 3)^2 = 1$

Finally,

The Euclidean Distance can be calculated by the root of the summation of the above individual results. From Calculation, we get

Euclidean distance = 1.8125. Now, we need to normalize it, for that we can do the following

$$\text{Result} = (1 / (1 + \text{Euclidean Distance}))$$

For our example it comes out to be 0.356. 'Result' value always lies between 0 and 1, the value 1 corresponds to the highest similarity.

## Calculating Prediction

Once we make a model using one of the similarity measures described above, we can predict the rating for any user-item pair by using the idea of weighted sum. First, we take all the items similar to our target item, and from those similar items, we pick items which the active user has rated. We weight the user's rating for each of these items by the similarity between that and the target item. Finally, we scale the prediction by the sum of similarities to get a reasonable value for the predicted rating:

$$P_{u,i} = \frac{\sum_{\text{all similar items}, N} (S_{i,N} * R_{u,N})}{\sum_{\text{all similar items}, N} (|S_{i,N}|)}$$

$P_{u,i}$  means we are going to predict the rating user u will give item i

$R_{u,N}$  is the rating user u gave item N

$S_{i,N}$  is the similarity between i and N

The above formula can be used to predict the ratings for any user-item pair. And the list of items having prediction value above a certain threshold can be displayed as a recommendation to the user. [13]

## Chapter 5: Implementation and Testing

### 5.1 Implementation

#### 5.1.1 Tools Used

##### Design & Development Tools

###### Visual Studio Code

Visual Studio Code is “a free-editor that helps the programmer write code, helps in debugging and corrects the code using the intelli-sense method”. In normal terms, it facilitates users to write the code in an easy manner. Features including support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git makes Visual Studio Code one of the most used code editors. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality. [14]

In the project, Visual Studio Code was used as the main code editor to write the codes for the platform. We chose Visual Studio Code as the primary code editor for the project as it is an open-source software with a user-friendly interface and support for multiple programming languages and added functionality like debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, embedded Git, etc.

###### Figma

Figma is a design platform for teams who build products together. Born on the Web, Figma helps teams create, share, test, and ship better designs from start to finish. Whether it’s consolidating tools, simplifying workflows, or collaborating across teams and time zones, Figma makes the design process faster, more efficient, and fun while keeping everyone on the same page. [15]

In the project, Figma was used as a tool to develop prototypes. We chose Figma as the tool for prototyping as it is open source, easy to use, both desktop and web based with proper syncing, easy sharing options, wireframing feature, vector based and easy modification.

## Front End Tools

A “front-end” application is one that applications & users interact with directly. It must have a graphical user interface that assists employees that are not from IT background. It must be scalable and flexible.

The front-end tools we have used in making this web application are:

### 1. Hypertext Markup Language (HTML)

HTML5 is used as the front end for our project. It is a markup language that is used for structuring and presenting the content on the World Wide Web.

### 2. Cascading Style Sheets (CSS)

CSS3 is used for presenting our document that is written in HTML5. CSS is intended to enable the separation of presentation and content, along with layout, content, fonts and colors.

### 3. JavaScript (JS)

JS is used for both backend and frontend. It is characterized by dynamic, prototyped based and multi-paradigm.

## Back End Tools

### 1. PHP (Hypertext Preprocessor)

PHP is a general-purpose scripting language geared towards web development. It is Fast, flexible and pragmatic, PHP powers everything from your blog to the most popular websites in the world. [16]

### 2. MySQL

MySQL is an open-source relational database management system (RDBMS). A relational database organizes data into one or more data tables in which data types may be related to each other; these relations help structure the data. SQL is a language programmers use to create, modify and extract data from the relational database, as well as control user access to the database. [17]

### 5.1.2 Implementation Details of Modules

```

function similarity_distance ($matrix, $person1,$person2)
{
    $similar=array();
    $sum=0;
    foreach($matrix[$person1] as $key=>$value)
    {
        if(array_key_exists($key,$matrix[$person2]))
        {
            $similar[$key]=1;
        }
        if($similar==0)
        {
            return 0;
        }
        foreach($matrix[$person1] as $key=>$value)
        {
            if(array_key_exists($key,$matrix[$person2]))
            {
                $sum=$sum+pow($value-$matrix[$person2][$key],2);
            }
        }
        return 1/(1+sqrt($sum));
    }
}

```

The above code snippet is equivalent to the formula for the calculation of Euclidean Distance i.e.,

$$\sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

where n is the total number of items that both users have rated, x and y are the two distance elements (i.e., rating values).

This formula is used to calculate the similarity between two users who have purchased and rated at least one common item.

The last line of code i.e., `return 1/(1+sqrt($sum));` is used to normalize the Euclidean Distance value so obtained to make the values exist within a range of 0 to 1. With value near to 1 corresponding to higher similarity.

```

<?php

session_start();
include("includes/config.php");
include('recommend1.php');

$products = mysqli_query($con, "select * from productreviews");

$matrix = array();
while ($product = mysqli_fetch_array($products)) {
    $matrix[$product['name']][$product['productName']] = $product['value'];
}
echo "<h2>Matrix Formed</h2>";
echo "<pre>";
print_r($matrix);
echo "</pre>";

?>

```

The above code snippet creates a matrix using the data from the table productreviews in the database.

For the sample data so provided:

User/Product	Agni OPC Cement	Agni OPC	Laxmi Bricks	Panchakanya Steel Rod	Jagadamba Steel Rod	Swastik Bricks
User 1	5	3	2			
User 2	2	2	5			2
User 3	2			4	5	4
User 4	5		3			4
User 5	4	3	2	3		4

Here, we can see that there are 5 users i.e., User 1, User 2, User 3, User 4 and User 5 and 6 products i.e., Agni OPC Cement, Agni OPC, Laxmi Bricks, Panchakanya Steel Rod, Jagadamba Steel Rod and Swastik Bricks.

With an assumption that the Users have purchased and rated certain set of products, we can see this data in the table stored as productreviews in the database to create a matrix.

The matrix so formed from the code is displayed as:

```

Matrix Formed

Array
(
    [User1] => Array
        (
            [Agni OPC Cement] => 5
            [Agni OPC] => 3
            [Laxmi Bricks] => 2
        )

    [User2] => Array
        (
            [Agni OPC Cement] => 2
            [Agni OPC] => 2
            [Laxmi Bricks] => 5
            [Swastik Bricks] => 2
        )

    [User3] => Array
        (
            [Agni OPC Cement] => 2
            [Swastik Bricks] => 4
            [Panchakanya Steel Rod] => 4
            [Jagadamba Steel Rod] => 5
        )

    [User4] => Array
        (
            [Agni OPC Cement] => 5
            [Laxmi Bricks] => 3
            [Swastik Bricks] => 4
        )

    [User5] => Array
        (
            [Agni OPC Cement] => 4
            [Agni OPC] => 3
            [Laxmi Bricks] => 2
            [Swastik Bricks] => 4
            [Panchakanya Steel Rod] => 3
        )
)

```

This matrix is then used for the calculation of the prediction.

```

function getRecommendation($matrix, $person)
{
    $total = array();
    $simsums = array();
    $ranks = array();

    foreach ($matrix as $otherPerson => $value) {
        if ($otherPerson != $person) {
            $sim = similarity_distance($matrix, $person, $otherPerson);
            foreach ($matrix[$otherPerson] as $key => $value) {
                if (!array_key_exists($key, $matrix[$person])) {
                    if (!array_key_exists($key, $total)) {
                        $total[$key] = 0;
                    }
                    $total[$key] += $matrix[$otherPerson][$key] * $sim;

                    if (!array_key_exists($key, $simsums)) {
                        $simsums[$key] = 0;
                    }
                    $simsums[$key] += $sim;
                }
            }
        }
    }

    foreach ($total as $key => $value) {
        $ranks[$key] = $value / $simsums[$key];
    }
    array_multisort($ranks, SORT_DESC);
    return $ranks;
}

```

The above code snippet is equivalent to the formula:

$$P_{u,i} = \frac{\sum_{\text{all similar items}, N} (S_{i,N} * R_{u,N})}{\sum_{\text{all similar items}, N} (|S_{i,N}|)}$$

where,

$P_{u,i}$  means we are going to predict the rating user  $u$  will give item  $i$

$R_{u,N}$  is the rating user  $u$  gave item  $N$

$S_{i,N}$  is the similarity between  $i$  and  $N$

This formula is used to predict the ratings for any user-item pair, which is the set of items that a particular user has not purchased yet.

For a test user i.e., User 1

In the sample data table, we can see that User 1 has purchased and rated 3 products which include Agni OPC Cement, Agni OPC and Laxmi Bricks. So, the above formula calculates the predicted rating for the remaining 3 products which are Panchakanya Steel Rod, Jagadamba Steel Rod and Swastik Bricks, which displays the output as:

```

{
    [Agni OPC Cement] => 2
    [Swastik Bricks] => 4
    [Panchakanya Steel Rod] => 4
    [Jagadamba Steel Rod] => 5
}
[User4] => Array
(
    [Agni OPC Cement] => 5
    [Laxmi Bricks] => 3
    [Swastik Bricks] => 4
)
[User5] => Array
(
    [Agni OPC Cement] => 4
    [Agni OPC] => 3
    [Laxmi Bricks] => 2
    [Swastik Bricks] => 4
    [Panchakanya Steel Rod] => 3
)
Prediction
Array ([Jagadamba Steel Rod] => 5 [Swastik Bricks] => 3.7402133052243 [Panchakanya Steel Rod] => 3.33333333333333)

```

```

<?php
    $query = mysqli_query($con, "SELECT COUNT(*) from productreviews WHERE name='"
    . $_SESSION['username'] . "'");
    $count = mysqli_fetch_array($query);
?>

<?php
    if (strlen($_SESSION['login']) && $count[0] >= 1) { ?>
        <!-- user logged in and at least one reviewed item -->

```

The above code snippet corresponds to the condition required to receive recommendation which includes:

1. The user should be registered and logged in
2. The user must have purchased and rated at least one product

```

<div class="panel panel-default">
    <div class="panel-body">
        <table class="table table-striped">
            <th> Recommended For You </th>
            <?php
                $recommendation = getRecommendation($matrix, 'User1');
                echo "<h2>Prediction</h2> ";
                print_r($recommendation);
                echo "<h2>Recommendation</h2> ";
                foreach ($recommendation as $product => $rating) {
                    if ($rating >= 3.5) {
?>
                    <tr>
                        <td>
                            <?php
                                $query = mysqli_query($con,
"select productName from productreviews where productName='$product'");
                                $proid = mysqli_fetch_array($query);
                                echo $proid[0];
?>
                        </td>
                    </tr>
                <?php } ?>
            <?php } ?>
        </table>
    </div>
</div>

```

The above code snippet returns the Recommended Items for a particular user.

In this case, the `getRecommendation` function has been called for User 1. In the previous figure, we have seen that User 1 has 3 predicted ratings. Here, we have kept a threshold of 3.5 defined by the code `if($rating >= 3.5) {`, which excludes any predicted rating less than 3.5 and returns the remaining items as recommendation for the user.

The output for the code can be displayed as:



```

[User1] => Array
(
    [Agni OPC Cement] => 2
    [Swastik Bricks] => 4
    [Panchakanya Steel Rod] => 4
    [Jagadamba Steel Rod] => 5
)

[User4] => Array
(
    [Agni OPC Cement] => 5
    [Laxmi Bricks] => 3
    [Swastik Bricks] => 4
)

[User5] => Array
(
    [Agni OPC Cement] => 4
    [Agni OPC] => 3
    [Laxmi Bricks] => 2
    [Swastik Bricks] => 4
    [Panchakanya Steel Rod] => 3
)

```

**Prediction**

Array ([ Jagadamba Steel Rod] => 5 [ Swastik Bricks ] => 3,7402133052243 [ Panchakanya Steel Rod ] => 3,3333333333333)

**Recommendation**

**Recommended For You**

Jagadamba Steel Rod  
Swastik Bricks

EXCLUDED (<3.5)

From the three predicted ratings, Panchakanya Steel Rod is excluded as the predicted rating is less than the defined threshold (i.e., 3.5) and the remaining two products are displayed as recommendation to the user.

The above result will be displayed to the user under RECOMMENDED FOR YOU in the homepage of the system with proper interface.

In the system itself, the user will receive recommendation if they satisfy the required criteria and the recommendation received is defined by the code:

```
<?php
    if ($count >= 1) {
        $recommendation = array();
        $recommendation = getRecommendation($matrix,
            htmlentities($_SESSION['username']));
    }
    foreach ($recommendation as $product => $rating) {
        if ($rating >= 3.5) {
    ?>
```

Here, the getRecommendation function is called for the user currently logged in into the system.

```
<?php
    $user_id = $_SESSION['id'];
    $sql = mysqli_query($con, "SELECT COUNT(*) from
        orders WHERE productId='$pid' and userId='$user_id' AND orderStatus='Delivered'");
    $count = mysqli_fetch_array($sql);
    ?>
    <?php
    if ($count[0] >= 1) {
    ?>
```

The above code snippet defines the condition required for a user to rate a particular product i.e., the user must have purchased the product and the orderStatus must be Delivered. Otherwise, it displays the output defined by the code:

```
<?php } else {
    echo
    "You must buy the product first to leave a review";
}
?>
```

## 5.2 Testing

### 5.2.1 Test Cases for Unit Testing

**Table 3 Test Table for Login**

Objective	To test the admin login
<b>Test I</b>	
Action	Admin credential was inserted, and login was initiated
Expected Result	The admin gets into the system and into the admin dashboard
Actual Result	The admin got into the system and into the admin dashboard
<b>Test II</b>	
Action	Wrong admin credentials were inserted for login
Expected Result	The admin doesn't get into the system, and error is displayed
Actual Result	The admin didn't get into the system, and error was displayed
Conclusion	Test Successful

**Table 4 Test Table for Cart**

Objective	To test the cart
<b>Test I</b>	
Action	Add to Cart is pressed for a product
Expected Result	The product is added to the cart
Actual Result	The cart was updated
<b>Test II</b>	
Action	The quantity for the product was increased and Update Cart was pressed
Expected Result	The product and the total price are updated in the cart
Actual Result	The cart was updated
<b>Test III</b>	
Action	The product was selected and Remove Item was clicked
Expected Result	The product is removed from the cart
Actual Result	The product was removed
Conclusion	Test Successful

**Table 5 Test Table for Search**

Objective	To test the search activity
<b>Test I</b>	
Action	Search for products using different credentials
Expected Result	The list is filtered according to the search credential
Actual Result	The list was filtered

**Table 6 Test Table for Recommendation**

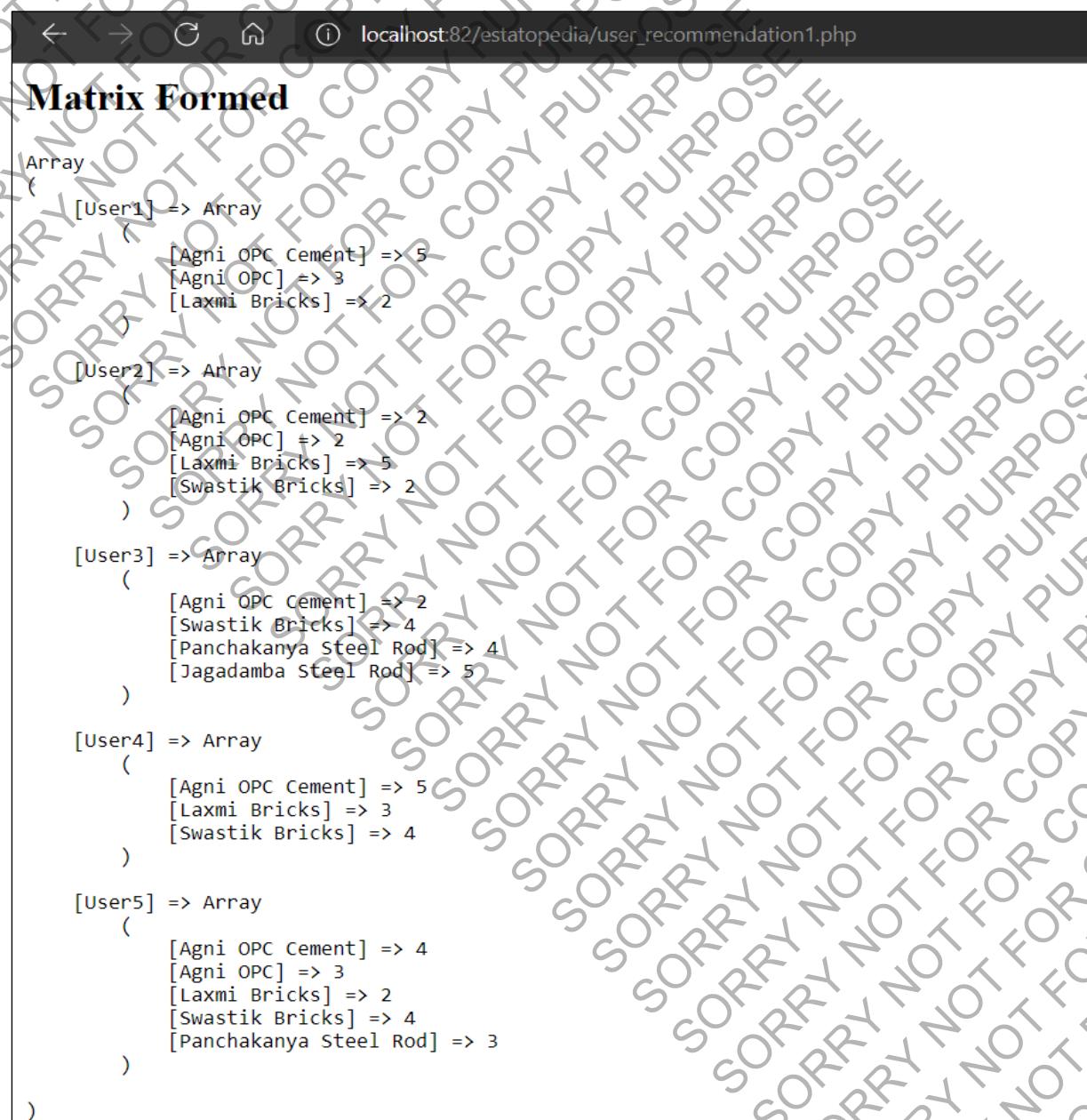
Objective	To test the recommendation system
<b>Test I</b>	
Action	User with at least one rated product logged into the system
Expected Result	Recommendation Section is displayed in the home page
Actual Result	The Recommendation Section was displayed
<b>Test II</b>	
Action	User with no rated products logged into the system
Expected Result	User is logged in but the Recommendation Section is not displayed in the system
Actual Result	The user got logged in but Recommendation Section was not displayed
<b>Test III</b>	
Action	Different users with rated products logged into the system
Expected Result	Each individual user should receive different recommendation based on their rated products
Actual Result	Different Recommendations were displayed for different user
Conclusion	Test Successful

### 5.2.2 Test Cases for System Testing

To test the proper functioning of the system as a whole, we take a test case as:

A new user (User 6) is created with the required credentials, then the user places an order for two products and these products are assumed to be Delivered by changing the orderStatus from the admin side. This allows the user to rate these products and we can confirm the addition of the RECOMMENDED FOR YOU section on the homepage once the products are rated.

Before the creation of User6, we have 5 registered users and 6 products with their own set of purchased and rated products for each user, which can be seen in the matrix as:



```

<--> C ① localhost:82/estatopedia/user_recommendation1.php

Matrix Formed

Array
(
    [User1] => Array
        (
            [Agni OPC Cement] => 5
            [Agni OPC] => 3
            [Laxmi Bricks] => 2
        )

    [User2] => Array
        (
            [Agni OPC Cement] => 2
            [Agni OPC] => 2
            [Laxmi Bricks] => 5
            [Swastik Bricks] => 2
        )

    [User3] => Array
        (
            [Agni OPC cement] => 2
            [Swastik Bricks] => 4
            [Panchakanya Steel Rod] => 4
            [Jagadamba Steel Rod] => 5
        )

    [User4] => Array
        (
            [Agni OPC Cement] => 5
            [Laxmi Bricks] => 3
            [Swastik Bricks] => 4
        )

    [User5] => Array
        (
            [Agni OPC Cement] => 4
            [Agni OPC] => 3
            [Laxmi Bricks] => 2
            [Swastik Bricks] => 4
            [Panchakanya Steel Rod] => 3
        )
)

```

After the user is created, the user logs in into the system and we can confirm there is no recommendation received by User6 as the user currently has no purchased and rated products. The user then places an order for two products i.e., Agni OPC Cement and Laxmi Bricks. The orderStatus of these products are changed to Delivered from the Admin Side. This allows the user to rate these products, the user is assumed to have provided a rating of 3 and 2 to the products Agni OPC Cement and Laxmi Bricks respectively. After rating the products, we can confirm the user receives Recommendation under the RECOMMENDED FOR YOU section in the homepage.

The change in the matrix after addition of the rating by User6 can be seen as:

### Matrix Formed

```

Array
(
    [User1] => Array
    (
        [Agni OPC Cement] => 5
        [Agni OPC] => 3
        [Laxmi Bricks] => 2
    )

    [User2] => Array
    (
        [Agni OPC Cement] => 2
        [Agni OPC] => 2
        [Laxmi Bricks] => 5
        [Swastik Bricks] => 2
    )

    [User3] => Array
    (
        [Agni OPC Cement] => 2
        [Swastik Bricks] => 4
        [Panchakanya Steel Rod] => 4
        [Jagadamba Steel Rod] => 5
    )

    [User4] => Array
    (
        [Agni OPC Cement] => 5
        [Laxmi Bricks] => 3
        [Swastik Bricks] => 4
    )

    [User5] => Array
    (
        [Agni OPC Cement] => 4
        [Agni OPC] => 3
        [Laxmi Bricks] => 2
        [Swastik Bricks] => 4
        [Panchakanya Steel Rod] => 3
    )

    [User6] => Array
    (
        [Agni OPC Cement] => 3
        [Laxmi Bricks] => 2
    )
)

```

The similarity of User6 with all the existing user calculated by using the Euclidean Distance

Theory is obtained as:

```
Similarity of User6 with User1 is 0.3333333333333333
Similarity of User6 with User2 is 0.24025307335204
Similarity of User6 with User3 is 0.5
Similarity of User6 with User4 is 0.30901699437495
Similarity of User6 with User5 is 0.5
```

Prediction includes the array of products and their predicted rating which the user has not purchased and rated. For User6, there are four products which the user has not purchased yet. The array of these products and their predicted ratings calculated using the concerned formula is obtained as:

### **Prediction**

```
Array ( [Jagadamba Steel Rod] => 5 [Swastik Bricks] => 3.6898499772806 [Panchakanya Steel Rod] => 3.5 [Agni OPC] => 2.7762144976353 )
```

### **Recommendation**

#### **Recommended For You**

```
Jagadamba Steel Rod
Swastik Bricks
Panchakanya Steel Rod
```

The predicted ratings calculated takes the Similarity value as one of the factors and the obtained values that satisfy the threshold value of 3.5 are displayed to the user as Recommendation. Here, we can see that the predicted ratings of three products i.e., Jagadamba Steel Rod, Swastik Bricks and Panchakanya Steel Road satisfy the criteria and hence displayed as Recommendation to User6 under the RECOMMENDED FOR YOU section in the homepage.

### 5.3 Result Analysis

The Recommendation received by a particular user is based on the products they have purchased and rated. As the number of rated products increases/decreases, the recommendations are also filtered accordingly as the Predicted Rating takes Similarity value as one of the calculation factors. In the above test case, if User6 is to rate only one product then the similarity score value changes as:

Similarity score for two rated products:

```
Similarity of User6 with User1 is 0.333333333333333
Similarity of User6 with User2 is 0.24025307335204
Similarity of User6 with User3 is 0.5
Similarity of User6 with User4 is 0.30901699437495
Similarity of User6 with User5 is 0.5
```

Similarity score for one rated product:

```
Similarity of User6 with User1 is 0.333333333333333
Similarity of User6 with User2 is 0.5
Similarity of User6 with User3 is 0.5
Similarity of User6 with User4 is 0.333333333333333
Similarity of User6 with User5 is 0.5
```

The Predicted Rating and Recommended Products also change accordingly as:

For two rated products:

#### Prediction

```
Array ( [Jagadamba Steel Rod] => 5 [Swastik Bricks] => 3.6898499772806 [Panchakanya Steel Rod] => 3.5 [Agni OPC] => 2.7762144976353 )
```

#### Recommendation

**Recommended For You**  
 Jagadamba Steel Rod  
 Swastik Bricks  
 Panchakanya Steel Rod

For one rated product:

#### Prediction

```
Array ( [Jagadamba Steel Rod] => 5 [Panchakanya Steel Rod] => 3.5 [Swastik Bricks] => 3.4545454545455 [Laxmi Bricks] => 3.1 [Agni OPC] => 2.625 )
```

#### Recommendation

**Recommended For You**  
 Jagadamba Steel Rod  
 Panchakanya Steel Rod

Hence, we can conclude that the ratings provided by the users filter the result of the recommendations they receive.

## Chapter 6: Conclusion and Future Recommendations

### 6.1 Conclusion

The system, Estatopedia - web portal for construction with a recommendation system based on collaborative filtering was implemented successfully. After doing background study and literature review of similar systems, we decided to integrate recommendation features in our system to make the overall ecommerce site experience better. Evolutionary prototyping was the selected development methodology as the initial requirement was concise and clear which helped to build the prototype of the system. Based on the prototype the development was further proceeded with multiple iteration while making necessary changes till the intended system was developed. Testing was done in each iteration based on the requirement. Later on, unit testing was done on each component of system then finally system testing was performed to confirm the proper functionality of the system. Using this system, the end user would be able to explore their construction needs within a single platform with added feature of recommendation. The recommendation is done by analyzing the similarities between the rating of multiple users on the same product using Euclidean distance theory and then calculating the prediction based on the similarity for different products to recommend.

### 6.2 Future Recommendations

As we have implemented collaborative filtering algorithm for the recommendation, it is recommended to use a large data set to make the recommendation for greater accuracy. In future, the system will integrate features like suppliers panel which allows users to get direct service for suppliers. Likewise, we can introduce the features to upload the user's construction plan and based on that we shall recommend the products and equipment. The feature of online transaction can also be implemented in the future.

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## Appendices

Some of the screenshots of the system are as follows:



Screenshot 1 UI of the system

**SIGN IN**

Already a member? [LOGIN](#)

Email Address \*  
user1@test.com

Password \*  
•••

[LOGIN](#)

**CREATE A NEW ACCOUNT**

New Here? [SIGNUP](#)

Full Name \*

Email Address \*

Contact No. \*

[Forgot your Password?](#)

Password \*

Confirm Password \*

[SIGN UP](#)

**ESTATOPEDIA**

- [Access Admin Panel](#)

Estatopedia - Group 5

**CONTACT US**

- Nepal
- +977 (0) 234567890

Screenshot 2 User Login Interface

ESTATOPEDIA | Admin

[Back to Portal](#)

**Sign In**

Username

Password

[Login](#)

© ESTATOPEDIA

Screenshot 3 Admin Login Interface



**Screenshot 4 Admin Dashboard Interface**



**Screenshot 5 Order Management Interface**

**ESTATOPEDIA | Admin**

**Insert Product**

Category	Select Category
Sub Category	
Product Name	Enter Product Name
Product Company	Enter Product Company Name
Product Price Before Discount	Enter Product Price
Product Price After Discount (Selling Price)	Enter Product Price
Product Description	<div style="border: 1px solid #ccc; padding: 5px;">Rich Text Editor</div>
Product Shipping Charge	Enter Product Shipping charge
Product Availability	Select
Product Image	<input type="file" value="Choose File"/> No file chosen <input type="button" value="Insert"/>

© ESTATOPEDIA

**Screenshot 6 Adding Product Interface**

**ESTATOPEDIA | Admin**

**Manage Products**

#	Product Name	Category	Subcategory	Company Name	Action
1	Agni OPC Cement	Cement	Ram Traders Pvt. Ltd.	Agni	
2	Agni OPC	Cement	Shree Laxmi Suppliers	Agni	
3	Laxmi Bricks	Bricks	Shree Laxmi Suppliers	Laxmi	
4	Panchakanya Steel Rod	Steel	Ram Traders Pvt. Ltd.	Panchakanya	
5	Jagadamba Steel Rod	Steel	Ram Traders Pvt. Ltd.	Jagadamba	
6	Swastik Bricks	Bricks	Shree Laxmi Suppliers	Swastik	

Showing 1 to 6 of 6 entries

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**Screenshot 7 Manage Product Interface**

Welcome User | My Account | My Cart | Logout | Track Order

ESTATOPEDIA

Search Something

CART - RS. 650.00

HOME CEMENT STEEL BRICKS

Home / Shopping Cart

Remove	Image	Product Name	Quantity	Price Per unit	Shipping Charge	Grand Total
		AGNI OPC CEMENT ★★★★★ (15 Reviews)	1	RS 650.00	RS 0.00	650.00

CONTINUE SHOPPING UPDATE CART REMOVE ITEM

SHIPPING ADDRESS

Billing Address

GRAND TOTAL 650.00

PROCEED TO CHECKOUT

ESTATOPEDIA

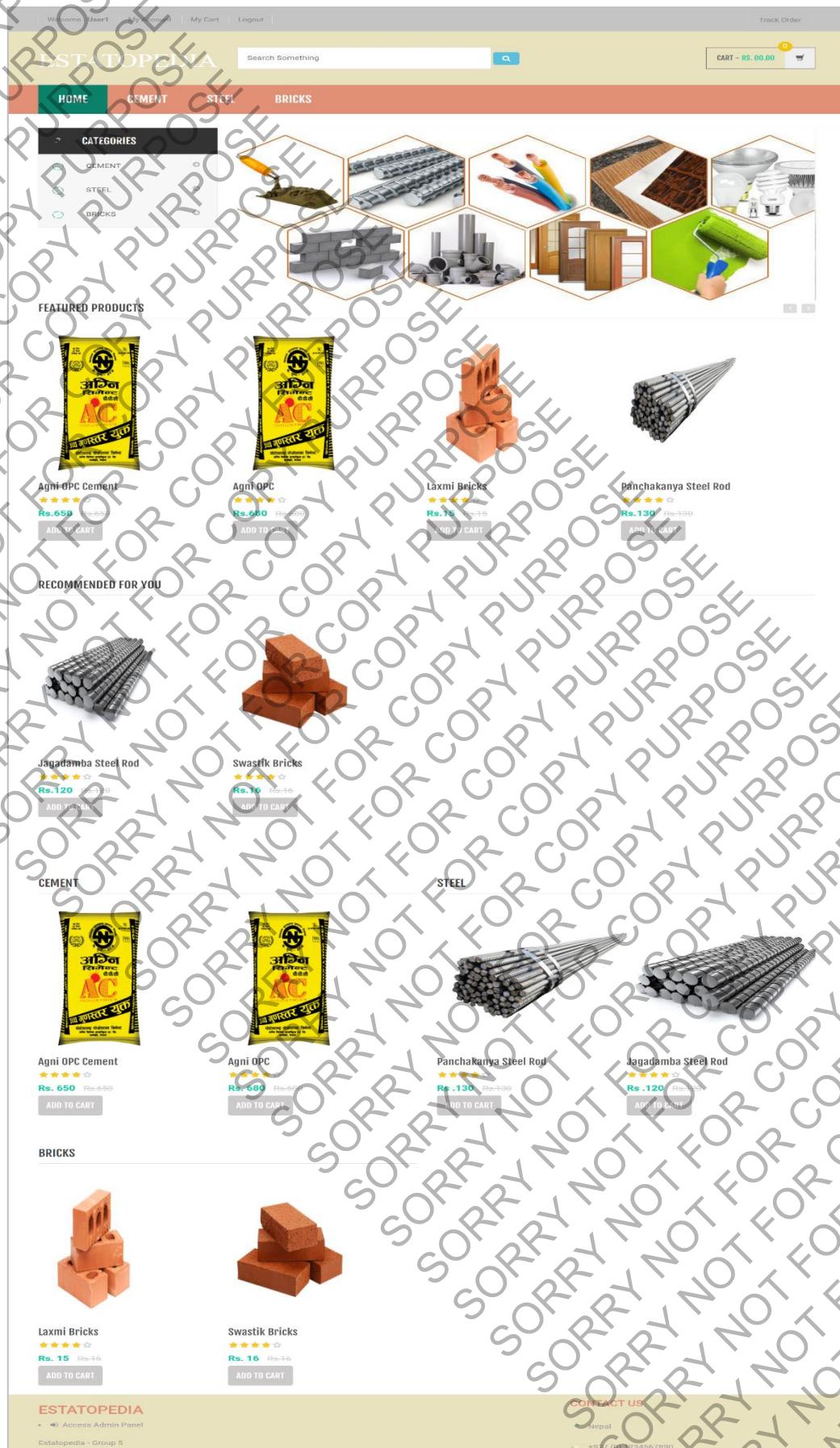
- Access Admin Panel

Estatopedia - Group 5

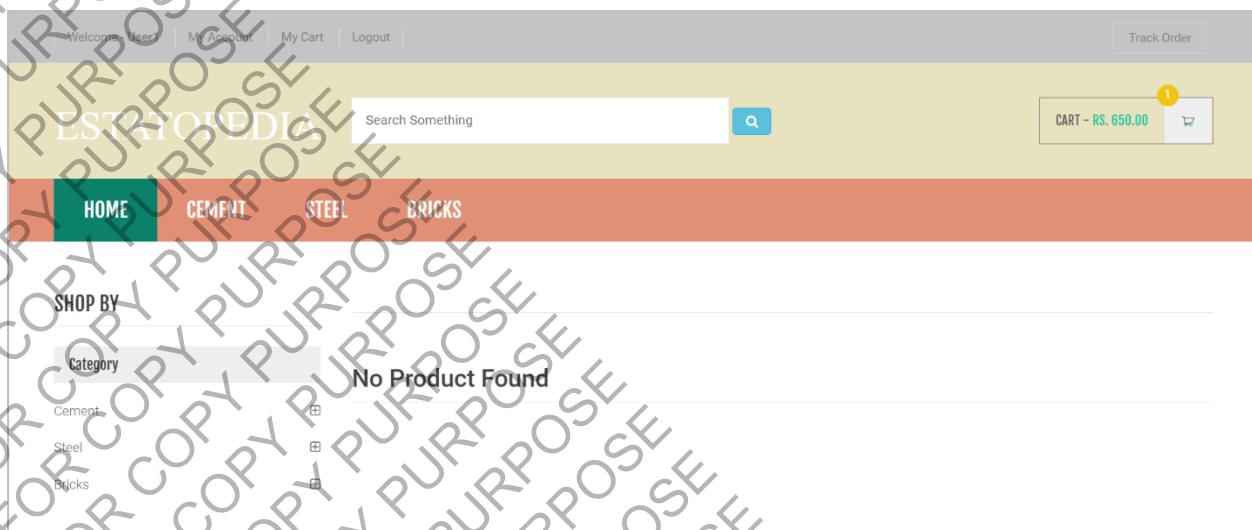
CONTACT US

Nepal  
+977 (0) 1234567890

Screenshot 8 My Cart Interface



Screenshot 9 Homepage with Recommendation after User Login



**Screenshot 10 Product Search Interface**

This screenshot shows the user account interface. At the top, it features the same navigation bar as Screenshot 10. The main content area is divided into sections: 'MY PROFILE' (with a green '1'), 'Personal info' (containing fields for Name\*, Email Address\*, and Contact No.\*), and 'CHANGE PASSWORD' (with a grey '2'). To the right, there's a 'YOUR CHECKOUT PROGRESS' section with tabs for 'My Account', 'Shipping / Billing Address', and 'Order History'. At the bottom, there's a yellow footer bar with the text 'ESTATOPEDIA' and a link to 'Access Admin Panel'. It also includes a 'CONTACT US' section with 'Nepal' and a phone number '+977 (0) 123456789'. The footer also contains the text 'Estatopedia - Group 5'.

**Screenshot 11 User Account Interface**

## Screenshots for System Testing

**CREATE A NEW ACCOUNT**

New Here | SIGNUP

Full Name\*

User6

Email Address\*

user6@test.com

Email available for Registration.

Contact No.\*

6666666666

Password.\*

....

Confirm Password.\*

....

**SIGN UP**

**ESTATOPEDIA**

- Access Admin Panel

Estatopedia - Group 5

**CONTACT US**

Nepal

+977 (0) 123456789

Testing Screenshot 1 User6 Creating with the required Credentials

Welcome User | My Account | My Cart | Logout | Track Order

CART - RS. 0.00

**HOME CEMENT STEEL BRICKS**

**CATEGORIES**

CEMENT  
STEEL  
BRICKS

**FEATURED PRODUCTS**

Agni OPC Cement  
Rs. 650 ADD TO CART

Agni OPC  
Rs. 680 ADD TO CART

Laxmi Bricks  
Rs. 15 ADD TO CART

Panchakanya Steel Rod  
Rs. 130 ADD TO CART

**CEMENT**

**STEEL**

**Testing Screenshot 2 User6 Logged in and initial homepage with no Recommendations**

Welcome User6 | My Account | My Cart | Logout | Track Order

ESTATOPEDIA

Search Something

CART - RS. 715.00 2

HOME CEMENT STEEL BRICKS

Home / Shopping Cart

Product Name	Quantity	Price Per unit	Shipping Charge	Grand Total
AGNI OPC CEMENT ★★★★★ (5 Reviews)	10	RS 650.00	RS 0.00	6500.00
LAXMI BRICKS ★★★★★ (5 Reviews)	100	RS 15.00	RS 50.00	1550.00

**CONTINUE SHOPPING**

**UPDATE CART** **REMOVE ITEM**

**SHIPPING ADDRESS**

**BILLING ADDRESS**

**GRAND TOTAL** **8050.00**

**PROCEED TO CHECKOUT**

**CONTACT US**

Nepal  
+977 10 1234567890

**ESTATOPEDIA**

- Access Admin Panel

Estatopedia - Group 5

Testing Screenshot 3 My Cart for User6 with two products

Welcome User | My Account | My Cart | Logout | Track Order

ESTATOPEDIA

Search Something

CART - RS. 00.00

HOME CEMENT STEEL BRICKS

Home / Shopping Cart

#	Image	Product Name	Quantity	Price Per unit	Shipping Charge	Grandtotal	Payment Method	Order Date	Action
1		AGNI OPC CEMENT	10	650	0	6500	COD	2022-04-17 00:22:50	Track
2		LAXMI BRICKS	100	15	50	1550	COD	2022-04-17 00:22:50	Track

ESTATOPEDIA

- Access Admin Panel
- Estatopedia - Group 5

CONTACT US

Nepal

+977 (0) 1234567890

Testing Screenshot 4 Confirmed Order for User6 within Track Order

localhost:82/estatopedia/track-order.php?oid=45

**Order Tracking Details**

<b>Order Id:</b>	45
<b>Order Date:</b>	2022-04-17 00:23:32
<b>Status:</b>	Delivered
<b>Remark:</b>	delivered

**Product Delivered Successfully**

localhost:82/estatopedia/track-order.php?oid=46

**Order Tracking Details**

<b>Order Id:</b>	46
<b>Order Date:</b>	2022-04-17 00:23:40
<b>Status:</b>	Delivered
<b>Remark:</b>	delivered

**Product Delivered Successfully**

Testing Screenshot 5 Status of Order set to Delivered

Welcome User | My Account | My Cart | Logout | Track Order

EST. TO IDEAS

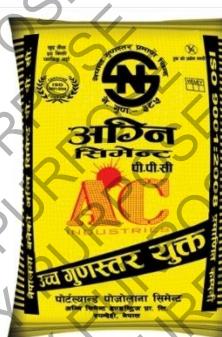
Search Something

CART - RS. 00.00

HOME CEMENT STEEL BRICKS

CATEGORY

Cement  
Steel  
Bricks



Agni OPC Cement

★★★★★ (5 Reviews)

AVAILABILITY : In Stock

PRODUCT BRAND : Agni

SHIPPING CHARGE : Free

Rs. 650 Re.650

QTY: 1 ADD TO CART

DESCRIPTION

REVIEW

CUSTOMER REVIEWS

- 2022-01-02 18:04:39  
"Great"  
Rating : 5 Star  
User1
- 2022-01-02 18:06:22  
Bad  
Rating : 2 Star  
User2
- 2022-01-02 18:07:47  
Bad Quality  
Rating : 2 Star  
User3
- 2022-01-02 18:09:04  
"Great"  
Rating : 5 Star  
User4
- 2022-01-02 18:10:21  
Satisfied  
Rating : 4 Star  
User5

Leave your own review

1 star 2 stars 3 stars 4 stars 5 stars

Rating

Your Name \* User6

Product Name Agni OPC Cement

Review good

SUBMIT REVIEW

Testing Screenshot 6 User6 rating Agni OPC Cement with 3 stars

Laxmi Bricks

**Rs. 15** Rs.15

ADD TO CART

CUSTOMER REVIEWS

Leave your own review

Rating

Your Name \*

User6

Review \*

bad

Product Name \*

Laxmi Bricks

SUBMIT REVIEW

Testing Screenshot 7 User6 rating Laxmi Bricks with 2 stars

Welcome - User6   My Account   My Cart   Logout   Track Order

EST. 2016 | MEDIA

Search Something

CART - RS. 0.00

**HOME**   CEMENT   STEEL   BRICKS

**CATEGORIES**

- CEMENT
- STEEL
- BRICKS

**FEATURED PRODUCTS**

Agni OPC Cement

★★★★★  
Rs. 650 Rs. 650

[ADD TO CART](#)

Agni OPC

★★★★★  
Rs. 680 Rs. 680

[ADD TO CART](#)

Laxmi Bricks

★★★★★  
Rs. 15 Rs. 15

[ADD TO CART](#)

Panchakanya Steel Rod

★★★★★  
Rs. 130 Rs. 130

[ADD TO CART](#)

**RECOMMENDED FOR YOU**

Jagadamba Steel Rod

★★★★★  
Rs. 120 Rs. 120

Predicted Rating: 5

[ADD TO CART](#)

Swastik Bricks

★★★★★  
Rs. 16 Rs. 16

Predicted Rating: 3.6898499772806

[ADD TO CART](#)

Panchakanya Steel Rod

★★★★★  
Rs. 130 Rs. 130

Predicted Rating: 3.5

[ADD TO CART](#)

**Testing Screenshot 8 Recommendations received by User6 under RECOMMENDED FOR YOU section in the homepage after rating**

## Code for Recommendation

```

<?php
function similarity_distance ($matrix, $person1,$person2)
{
    $similar=array();
    $sum=0;
    foreach($matrix[$person1] as $key=>$value)
    {
        if(array_key_exists($key,$matrix[$person2]))
        {
            $similar[$key]=1;
        }
    }
    if($similar==0)
    {
        return 0;
    }
    foreach($matrix[$person1] as $key=>$value)
    {
        if(array_key_exists($key,$matrix[$person2]))
        {
            $sum=$sum+pow($value-$matrix[$person2][$key],2);
        }
    }
    return 1/(1+sqrt($sum));
}

function getRecommendation ($matrix, $person)
{
    $total=array();
    $simsums=array();
    $ranks=array();

    foreach ($matrix as $otherPerson=>$value)
    {
        if ($otherPerson!=$person)
        {
            $sim=similarity_distance ($matrix, $person, $otherPerson);
            foreach($matrix[$otherPerson] as $key=>$value)
            {
                if(!array_key_exists($key,$matrix[$person]))
                {
                    if(!array_key_exists($key,$total))
                    {
                        $total[$key]=0;
                    }
                    $total[$key]+=$matrix[$otherPerson][$key]*$sim;

                    if(!array_key_exists($key,$simsums))
                    {
                        $simsums[$key]=0;
                    }
                    $simsums[$key]+=$sim;
                }
            }
        }
    }

    foreach($total as $key=>$value)
    {
        $ranks[$key]=$value/$simsums[$key];
    }
    array_multisort($ranks,SORT_DESC);
    return $ranks;
}

```

```
<!-- ===== RECOMMENDATION TAB START ===== -->

<?php
$query = mysqli_query($con, "SELECT COUNT(*) from productreviews WHERE name='$_SESSION['username']'");
$count = mysqli_fetch_array($query);
// echo $count[0];
?>

<?php
if (strlen($_SESSION['login'])) && $count[0] >= 1 { ?>
    <!-- user logged in and at least one reviewed item -->
    <div id="product-tabs-slider" class="scroll-tabs inner-bottom-vs wow fadeInUp">
        <div class="more-info-tab clearfix">
            <h3 class="new-product-title pull-left">Recommended For You</h3>
        </div>
        <div class="tab-content outer-top-xs">
            <div class="tab-pane in active">
                <div class="product-slider">
                    <div class="owl-carousel home-owl-carousel custom-carousel owl-theme" data-item="4">
                        <?php
                            include('recommend1.php');
                        ?>
                        $products = mysqli_query($con, "select * from productreviews");
                        $matrix = array();
                        while ($product = mysqli_fetch_array($products)) {
                            $matrix[$product['name']][$product['productName']] = $product['value'];
                        }
                    ?>
                    <?php
                        if ($count >= 1) {
                            $recommendation = array();
                            $recommendation = getRecommendation($matrix, htmlentities($_SESSION['username']));
                            foreach ($recommendation as $product => $rating) {
                                if ($rating >= 3.5) {
                            ?>
                                <?php
                                    $query = mysqli_query($con,
                                        "select productId from productreviews where productName='$_product'");
                                    $proid = mysqli_fetch_array($query);
                                ?>
                                <div class="item-item-carousel">
                                    <div class="products">
                                        <div class="product">
                                            <div class="product-image">
                                                <div class="image">
                                                    <a href="product-details.php?pid=<?php echo $proid[0]; ?>">
                                                        <?php
                                                            $query = mysqli_query($con,
                                                                "select productImage1 from products where id='$_proid[0]'");
                                                        ?>
                                                        <?php echo $proimage[0]; ?>" data-echo="admin/productimages/<?php echo $proid[0]; ?> /<?php echo $proid[0]; ?>/<?php echo $proimage[0]; ?>" width="180" height="300" alt=""></a>
                                                <?php
                                                    $proimage = mysqli_fetch_array($query);
                                                    // echo $proimage[0];
                                                ?>
                                                
                                            </div><!-- .image -->
                                        </div>
                                    <div class="product-info text-left">
                                        <h3 class="name"><a href="product-details.php?pid=<?php echo $proid[0]; ?>"><?php echo $product; ?></a></h3>
                                        <div class="rating rateit-small"></div>
                                        <div class="description"></div>
                                        <div class="product-price">
                                            <span class="price">
                                                <?php
                                                    $query = mysqli_query($con,
                                                        "select productPrice from products where id='$_proid[0]'");
                                                    $proprice = mysqli_fetch_array($query);
                                                    // echo $proprice[0];
                                                ?>
                                            </span>
                                        </div>
                                    </div>
                                </div>
                            ?>
                        }
                    ?>
                </div>
            </div>
        </div>
    </div>
?>
```

```

    "select productPriceBeforeDiscount from products where id='$proid[0]'");

    <?php echo $proid[0]; ?> <span class="price-before-discount">
        <?php
            $query = mysqli_query($con,
                "select productPriceBeforeDiscount from products where id='
    Rs.<?php echo $propriice[0]; ?> </span>

        </div><!-- /.product-price -->
    </div><!-- /.product-info -->
    <div class="action"><a href="index.php?page=product&action=add&id=
        <?php
            $query = mysqli_query($con,
                "select * from products where id='
    </div><!-- /.product -->
    </div><!-- /.products -->
    <div><!-- /.item -->
        <?php } ?>
        <?php } ?>
        <?php } ?>
    </div><!-- /.home_owl-carousel -->
    </div><!-- /.product-slider -->
</div>
</div>
<?php } ?>
<!-- RECOMMENDATION TAB END -->

```