Ehsas-Hub

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Final Approval

This is to certify that we have read the report submitted by ***Zain Muneer 35937 Abdullah Shahid 35438 Hamza Ahmed 31967*** for the partial fulfillment of the requirements for the degree of the Bachelors of Science in Computer Science (BSCS). It is our judgment that this report is of sufficient standard to warrant its acceptance by Riphah International University, Islamabad for the degree of Bachelors of Science in Computer Science (BSCS).

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Declaration

We hereby declare that this document “**Ehsas hub**” neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanied report entirely on the basis of our personal efforts, under the proficient guidance of our teachers, especially our supervisor **Tajamul Shahzad,** if any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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Dedication

Our project is dedicated to our parents, seniors, friends, and our supervisor "**Tajamul Shahzad**" who has been our continual source of inspiration and whose support has helped this project succeed. This project would not have been possible without their love and support.

Acknowledgement

First of all, we are obliged to Allah Almighty the Merciful, the Beneficent and the source of all Knowledge, for granting us the courage and knowledge to complete this Project.

We are deeply grateful to our friends who helped us along the way, our families for their support, and our supervisor, **Tajamul Shahzad**, for his direction.

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Abstract

Ehsas Hub is a community-driven platform to connect donors, students, and volunteers toward a common cause: that is, making education accessible to the needy. Unlike most platforms focusing on money, Ehsas Hub is more interested in book sharing. By doing this, it pairs each donated book with a student who actually needs the book on what they are interested in and what they aim to do in the future. Ehsas Hub, through smart technology, makes book recommendations to each learner to learn and grow; system takes student interest like (Favorite book, author, and genres) and provide top rated books. It ensures that all that is done is open and honest so that trust may be built. This does not only get the right resources to the right students but empowers them to reach their full potential.

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Chapter 01:
Introduction

Chapter 1: Introduction

1.1 Introduction:

Many students today who don't have much money and access to basic learning materials like books, which are important for both learning and personal growth. On the other hand, many people and groups are ready to donate books but don't know how to get in touch with people who need them. Ehsas Hub, a digital platform that makes it easy for donors, students, and volunteers to meet, can fill this gap. The primary goal of this project is to make it easier for people to donate books and make sure that they get to the right people by using a personalized recommendation system that is based on academic interests, and preferences.

Ehsas Hub is more than just a place to donate; it's a step towards making education available to everyone. The platform improves the process of matching given books with people who can use them by adding a recommendation system. This way, every book donated has the chance to improve someone's education. The platform uses technology to get around the problems that come with traditional book donation methods, like matching people with the right books.

1.2 Goals and Objectives

1.2.1 Goals:

- **To develop a centralized book donation platform:** Goal is creating an online platform where people can contribute books, specifically educational material, to needy students. The idea is to simplify the process of donation and make books easily available to those in need.
- **To develop an AI-based book recommendation system:** Through machine learning algorithms, Ehsas Hub will suggest books to users from their preferred genre, favorite book, and requested book. The aim is to get users to discover appropriate education related content that is related with their interests.
- **To enable coordination of volunteers and donors:** The site will manage volunteers and donors using a simple-to-use interface. Volunteers will be able to monitor their work, while donors will be informed of their donations and the effect they are creating.

- **To Create a Scalable, Secure, and User-Friendly Web Application:** The aim is to have a platform that is scalable, secure, and reliable, enabling growth in the future. The application should be simple to use, supporting various user roles like students, donors, volunteers, and admin.

1.2.2 Objectives:

- **Develop Core Functionalities:** User Registration & Authentication: Provide users with the ability to register and securely log in with role-based access control (e.g., donors, volunteers, admin, needy).
- **Book Donation Management:** Provide a way for donors to submit books to donate, which will then be listed for needy users to request.
- **AI-Driven Book Recommendations:** Integrate a recommendation engine to recommend books to users based on their preferences and education needs.
- **Volunteer Task Administration:** Enable volunteers to monitor tasks involving book donation collection.
- **Admin Panel for Management:** Offer administrators with management tools for users, books, and donations

1.3 Scope of the Project

The project Ehsas Hub is meant to develop a detailed platform that would link donors, volunteers, and students in need of study materials, mostly in the form of book donation. The scope of the project comprises both functional and non-functional parts that facilitate an effortless user experience. Following are the important areas encompassed within the project's scope:

1.3.1 Functional Scope:

1.3.1.1 User Registration and Authentication:

- **Roles:** There will be several user roles on the platform, such as Admin, Donor, Volunteer, and Needy (Student).
- **Authentication**: User login and registration will be secured through JWT (JSON Web Tokens) for authenticating users.
- **Role-based Access Control (RBAC):** There will be different permissions for each type of user to access various sections of the platform.

1.3.1.2 Book Donation Management:

- **Donor Interface:** Donors can donate books (with fields like book name, author, genre, and book image).
- **Approval System:** Admin can approve/reject book donations based on specific parameters.
- **Book Availability:** Once approved, the books will be available for needy users to request.

1.3.1.3 Personalized Book Suggestions:

- **AI Integration:** An AI-powered recommendation system will recommend books to underprivileged students according to their interests, learning requirements, and past interactions with the platform.
- **Machine Learning Model:** NCF, Clustering or Hybrid Models, leveraging Tensor Flow and other machine learning algorithms, will drive the recommendation engine.

1.3.1.4 Volunteer Coordination:

- **Task Management:** Volunteers will be able to view and accept tasks associated with book collection from donors, which is near to them.

1.3.1.5 Admin Dashboard:

- **Admin Control:** Admin users will have total control over the platform, including user management (donors, volunteers, and needy), book approval, task allocation, and platform monitoring.
- **Data Overview:** Admins will be able to view all data, such as donation logs, volunteer tasks, user activity, and more.

1.3.1.6 Frontend Interface:

- **User interface:** The frontend is based on React, allowing a very intuitive and user-friendly interface for all kinds of users.
- **Dashboard:** This would comprise a specifically designed dashboard to track donations, book availability, volunteer activities and more.
- **Responsive Design:** The website will ensure mobile-friendliness and responsiveness across different types of devices.

1.3.1.7 Book Search and Request System:

- **Search Functionality:** Needy users are able to search for books by categories, subjects, and other parameters.
- **Request Process:** Needy users are able to request books using a simplified process and will get updates on email.

1.3.2 Non-Functional Scope:

1.3.2.1 Reliability

- The system should handle errors gracefully and should not lose data during Donations.
- The platform must be able to recover quickly from unexpected failures Like passwords etc.

1.3.2.2 Security

- Strong authentication (JWT) and password encryption should be implemented to ensure that user data is secure.
- Sensitive data, such as user information and donation details, should be encrypted both during transmission and storage.

1.3.2.3 Usability

- The platform should have an intuitive and easy-to-use interface for all user roles (admin, donor, volunteer, needy).
- It should be accessible on both desktop and mobile devices, providing a responsive design for different screen sizes.

1.3.2.4 Maintainability

- The system should be modular, with clearly defined components that can be easily updated or replaced in the future.
- Proper documentation and error logs should be maintained to help with ongoing support and updates.

1.3.2.5 Compatibility

- The platform should work on common web browsers like **Chrome**, **Firefox**, and **Safari, Web Browsers.**
- It should be compatible with both **Windows** and **Ubuntu Linux** operating systems.

1.3.2.6 Resource Efficiency

- The system should operate efficiently without excessive consumption of memory or CPU, ensuring smooth operation on typical hardware.

1.4 Conclusion:

The Ehsas Hub initiative aims to solve the issue of book availability by creating a platform that brings donors, volunteers, and students together. The principal objectives of the project are to make the process of donating simpler, enhance educational content access, and provide users with book recommendations based on AI. The goals include building essential features for user registration, donation management, and integrating AI, ensuring security, scalability, and usability throughout the platform.

Chapter 02:

Literature Review

Chapter 2: Literature Review

2.1 Introduction

In many areas, like e-commerce, entertainment, and education, recommendation systems are an important part of giving each user a personalized experience. This literature review is mostly about book recommendation systems, which try to match users with good books based on their likes, dislikes, and past actions. This chapter goes into definitions, linked research, and an analysis of methodologies. It then looks for research gaps and comes up with the Ehsas=Hub project's problem statement with an emphasis on book recommendation platforms; this chapter provides a thorough analysis of recommendation systems. It examines fundamental ideas, current studies, approaches used in comparable systems, and highlights important gaps pertinent to the Ehsas-Hub project.

2.2 Background and Problem Elaboration

Book recommendation systems have evolved from simple content-based methods to sophisticated hybrid approaches. The challenges addressed by these systems include handling vast datasets, improving recommendation accuracy, and overcoming issues like cold-start problems and sparsity in user feedback. For Ehsas Hub, the aim is to integrate a recommendation engine specifically tailored to students' interests and academic goals, leveraging techniques like collaborative filtering and machine learning.2.3 Detailed Literature Review

2.3 Detailed Literature Review

2.3.1 Definitions

- **Content-Based Filtering**: Recommends items similar to the ones the user has liked based on item attributes (e.g., genre, author).
- **Collaborative Filtering**: Makes recommendations by finding similarities among users or items based on user ratings or interactions.
- **Hybrid Systems**: Combines content-based and collaborative methods to overcome the limitations of each technique.

2.3.2 Related Research Work 1

A study by Gupta et al. (2020) explores the effectiveness of recommendation systems in e-commerce and library platforms. The research highlights the utility of content-based filtering for user-specific recommendations and discusses its limitation in handling new users (cold-start problem). Collaborative filtering, though powerful, requires extensive datasets to deliver accurate predictions.

2.3.3 Related Research Work 2

A personalized book recommendation system developed by Sarma et al. (2021) combines clustering techniques with cosine similarity to recommend books. The study uses datasets from Goodreads and applies machine learning models to improve recommendation accuracy. It effectively addresses sparsity and cold-start problems through clustering methods**.**

2.4 Literature Review Summary Table

Table 2.1: Literature Review Summary Table

STUDY	**Methodology**	STRENGTHS	**Limitations**
GUPTA ET AL. (2020)	Content-Based Filtering	Personalized recommendations	Struggles with cold-start problems
SARMA ET AL. (2021)	Clustering + Collaborative Filtering	High accuracy and handles sparsity well	Requires well-curated datasets
RAJPURKAR ET AL. (2015)	Hybrid (Content + Collaborative)	Improves recommendation relevance	Computationally intensive for large datasets

2.5 Research Gap

The research gap in current book recommendation systems is their narrow attention to user-specific goals and educational aims. The majority of current systems strongly depend on user ratings or common interests, which do not pay attention to the specific requirements of particular user segments, like students within an educational context. These systems usually face the cold-start problem, data sparsity, and computational complexity, in addition, although hybrid recommendation systems have been investigated, they are computationally expensive and need well-curated datasets, which makes them less appropriate for platforms that cater to a broad set of stakeholders. There is limited research that integrates personalized recommendations based on particular academic or educational objectives with scalable and efficient solutions for platforms such as Ehsas Hub. Thus, there is a requirement for a recommendation system that not only takes ratings into account but also encompasses user interests, academic objectives, and computational efficiency.

2.6 Problem Statement

Current book recommendation systems mainly concentrate on general-purpose recommendations, mostly overlooking the specific needs of nonprofit educational platforms such as Ehsas Hub. Issues including plague current systems:

- **Cold-Start Problem:** New members who have little or no historical information are problematic for personalized recommendations.
- **Data Sparsity**: Lack of user or item interaction data can lead to poor recommendations, particularly in collaborative filtering techniques.
- **Limited Personalization:** Most recommendation systems fail to well-personalize their suggestions with respect to precise academic interests, objectives, or user preferences.
- **Scalability Issues:** Current systems, particularly hybrid models, can be computationally intensive to handle large sets of data and thus are not appropriate for nonprofit platforms with limited resources.

2.7 Conclusion

In summary, current book recommendation systems are primarily based on user ratings, mostly ignoring deeper, more personalized ones like users' research interests or special preferences. Though content-based and collaborative filtering methods are generally employed, they have limitations when dealing with the special requirements of academic platforms, especially in suggesting books according to a user's research objectives or interests. Such systems are also faced with problems such as the cold-start issue, sparsity of data, and computational expense, particularly for nonprofit platforms like Ehsas Hub, that demand personalized recommendations for students. Most systems are unable to incorporate such personalized interests and are centered on ratings only. The literature clearly points out an evident void in developing scalable and efficient recommendation systems that trade-off both ratings and user-specific interests.

Ehsas Hub seeks to fill this gap by creating a solution that offers personalized book suggestions according to user interests and learning objectives alongside solving typical issues such as cold-start issues and data sparsity.

Chapter 03:
Requirements and Design

Chapter 3: Requirements and Design

3.1 Introduction:

In this chapter, we have developed our functional requirements for our actors i.e. (**Needy**, **Donor, Admin** and **Volunteer**). The requirements are designed for especially for Ehsas-Hub platform.

Ehsas-Hub is a web-based platform designed to connect or interact with Needy and Donors easily with each other with help of volunteer.

The platform is user-friendly, easy to navigate and search, and provide a convenient and efficient way for both parties to connect and interact with each other.

We created our system **use cases** against each functional requirement and created use case diagrams, fully dressed use cases for our actors i.e. (User, Admin, Donor and Volunteer).

3.2 Requirements

3.2.1 Functional Requirements

3.2.1.1 Needy:

Table 3.1: Functional Requirements of Needy

ID	REQUIREMENTS
FR-1.1	User will be able to Sign Up.
FR-1.2	User will be able to login to their account.
FR-1.3	User will be able to Forget/Recover their password.
FR-1.4	User will be able to view profile
FR-1.5	User will be able to edit/update their profile.
FR-1.6	User will be able to View Books Based on Recommendation with respect to their interest.
FR-1.7	User will be able to request specific books.
FR-1.8	User will be able to add book to favorite .

FR-1.9	User will be able to See favorite books.
FR-1.10	User will be able to remove favorite book
FR-1.11	User will be able to view book stats.
FR-1.12	User will be able to view requested books list.
FR-1.13	User will be able to search books.
FR-1.14	User will be able to give feedback.
FR-1.15	User will be able to Logout

3.2.1.2 Donor:

Table 3.2: Functional Requirements of Donor

ID	REQUIREMENTS
FR-2.1	Donor will be able to Sign Up.
FR-2.2	Donor will be able to Login.
FR-2.3	Donor will be able to forget/recover their Password.
FR-2.4	Donor will be to view profile.
FR-2.5	Donor will be able to edit profile.
FR-2.6	Donor will be able to donate books.
FR-2.7	Donor will be able to view donated book stats.
FR-2.8	Donor will be able to view donated book list.
FR-2.9	Donor will be able to give feedback.
FR-2.10	Donor will be able to Logout.

3.2.1.3 Volunteer:

Table 3.3: Functional Requirements of Volunteer

ID	REQUIREMENTS
FR-3.1	Volunteer will be able to sign up.
FR-3.2	Volunteer will be able to log in.
FR-3.3	Volunteer will be able to forget/recover password.
FR-3.4	Volunteer will be able to view profile.
FR-3.5	Volunteer will be able to edit profile.
FR-3.6	Volunteer will be able to check new request.
FR-3.7	Volunteer will be able to accept request.
FR-3.8	Volunteer will be able to check request in process.
FR-3.9	Volunteer will be able to view completed request.
FR-3.10	Volunteer will be able to logout.

3.2.1.4 Admin:

Table 3.4: Functional Requirements of Admin

ID	REQUIREMENTS
FR-4.1	Admin will be able to sign up.
FR-4.2	Admin will be able to login
FR-4.3	Admin will be able to forget/recover password.
FR-4.4	Admin will be able to view profile.
FR-4.5	Admin will be able to edit profile.
FR-4.6	Admin will be able to manage accounts.
FR-4.7	Admin will be able to approve account.

FR-4.8	Admin will be able to reject account.
FR-4.9	Admin will be able to freeze account.
FR-4.10	Admin will be able to active account.
FR-4.11	Admin will be able to view donor request.
FR-4.12	Admin will be able to accept request.
FR-4.13	Admin will be able to reject request.
FR-4.14	Admin will be able to view approved request.
FR-4.14	Admin will be able to view in process request.
FR-4.16	Admin will be able to view completed request.
FR-4.17	Admin will be able to view needy request.
FR-4.18	Admin will be able to accept needy request.
FR-4.19	Admin will be able to reject needy request.
FR-4.20	Admin will be able to view needy approved request.
FR-4.21	Admin will be able to view needy in process request
FR-4.22	Admin will be able to view needy completed request.
FR-4.23	Admin will be able to view volunteer request.
FR-4.24	Admin will be able to view volunteer approved request.
FR-4.25	Admin will be able to view volunteer completed request.
FR-4.26	Admin will be able to view account statistics.
FR-4.27	Admin will be able to view active list.
FR-4.28	Admin will be able to active book.
FR-4.29	Admin will be able to deactivate book.
FR-4.30	Admin will be able to view feedbacks.
FR-4.31	Admin will be able to log out.

3.2.2 Non-Functional Requirements

3.2.2.1 Reliability

- The system should handle errors gracefully and should not lose data during Donations.
- The platform must be able to recover quickly from unexpected failures like passwords etc.

3.2.2.2 Security

- Strong authentication (JWT) and password encryption should be implemented to ensure that user data is secure.
- Sensitive data, such as user information and donation details, should be encrypted both during transmission and storage.

3.2.2.3 Usability

- The platform should have an intuitive and easy-to-use interface for all user roles (admin, donor, volunteer, needy).
- It should be accessible on both desktop and mobile devices, providing a responsive design for different screen sizes.

3.2.2.4 Maintainability

- The system should be modular, with clearly defined components that can be easily updated or replaced in the future.
- Proper documentation and error logs should be maintained to help with ongoing support and updates.

3.2.2.5 Compatibility

- The platform should work on common web browsers like **Chrome**, **Firefox**, and **Safari, Web Browsers.**
- It should be compatible with both **Windows** and **Ubuntu Linux** operating systems.

3.2.2.6 Resource Efficiency

- The system should operate efficiently without excessive consumption of memory or CPU, ensuring smooth operation on typical hardware.

3.2.3 Hardware and Software Requirements

3.2.3.1 Hardware Requirements:

Server: Dedicated or cloud-based server with at least 16GB RAM and 500GB SSD.
Storage: Sufficient storage for books metadata, user data, and logs.
Processing Power: Capable of handling concurrent user requests and machine learning tasks.

3.2.3.2 Software Requirements:

Operating System: Windows Server.
Database: MySQL for storing user profiles, book details, and donation records.
Frontend: React.js for building the user interface.
Backend: Node.js with Express.js for server-side logic.
Recommendation System: Google Collab.

3.3 Proposed Methodology

The project will have an agile approach with iterative development and user feedback:

- **Requirement Gathering**: Identify user needs and define functionalities.
- **System Design**: Develop architecture and UI mockups.
- **Development**: Build core modules, including registration, Account management, donation management, and recommendation system.
- **Testing**: Validate functionality, performance, and security.

3.4 System Architecture

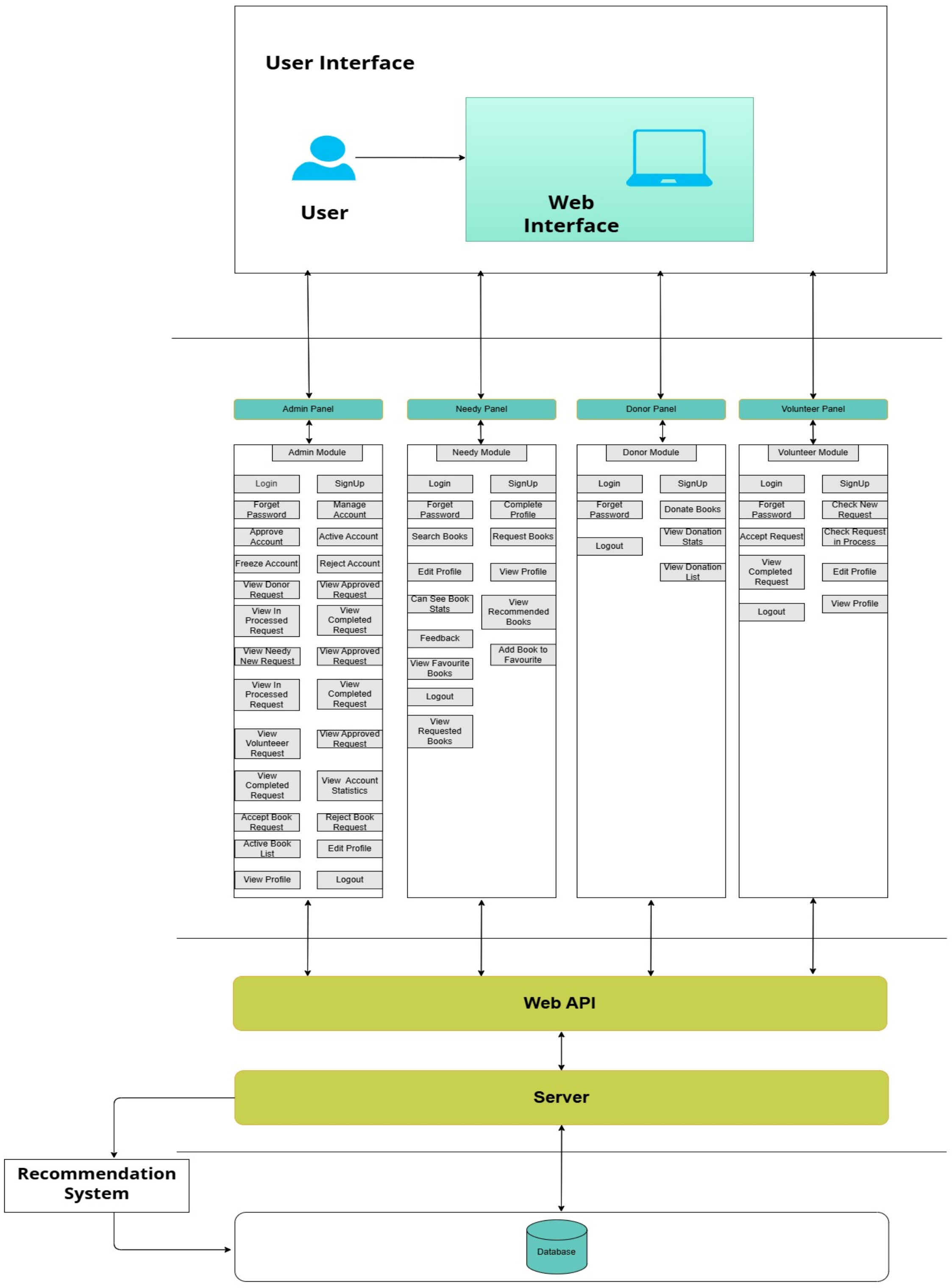


Figure 3.1: System Architecture

3.5 Use Cases

3.5.1 Admin Use-Case Diagram:

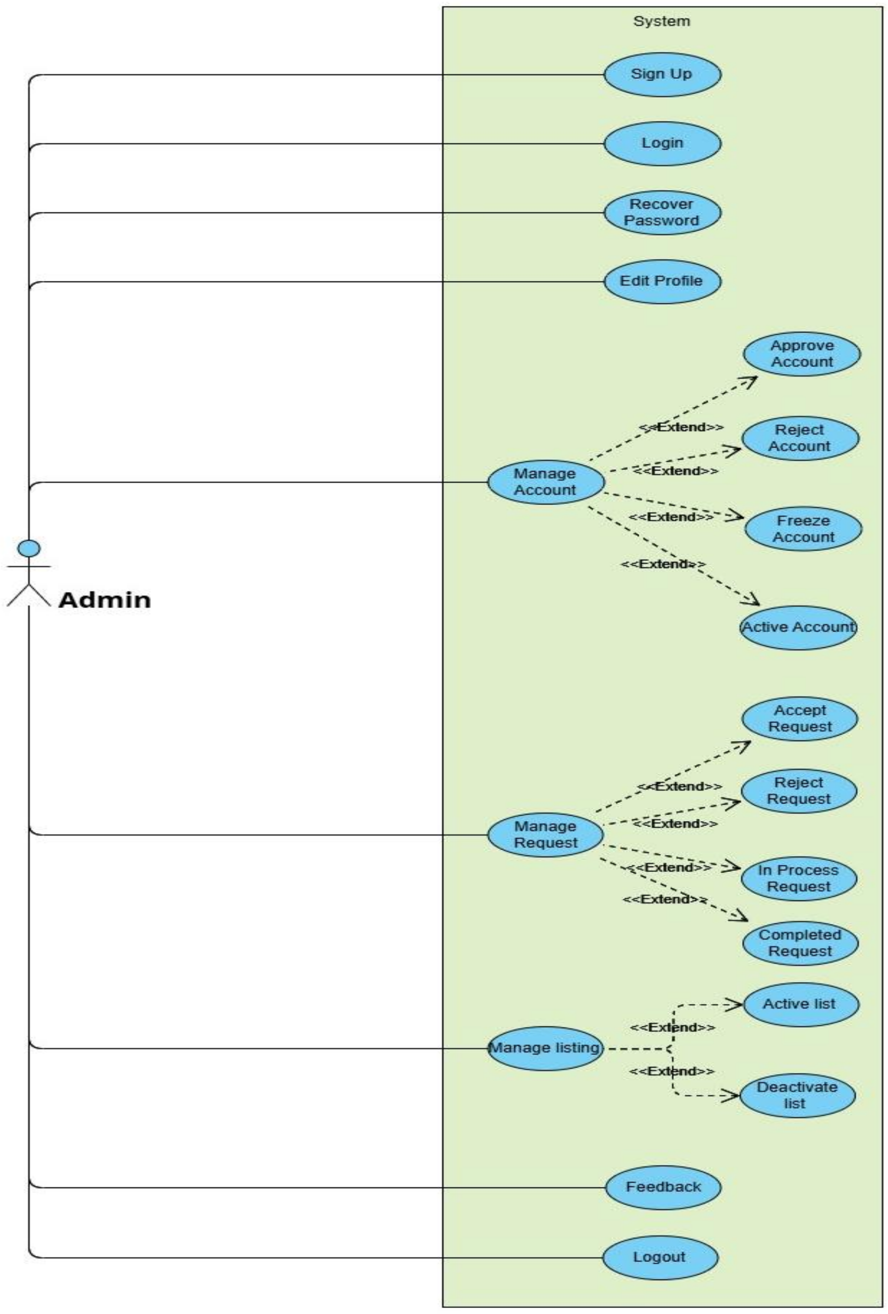


Figure 3.2: Admin Use-Case Diagram

3.5.2 Needy Use-case Diagram:

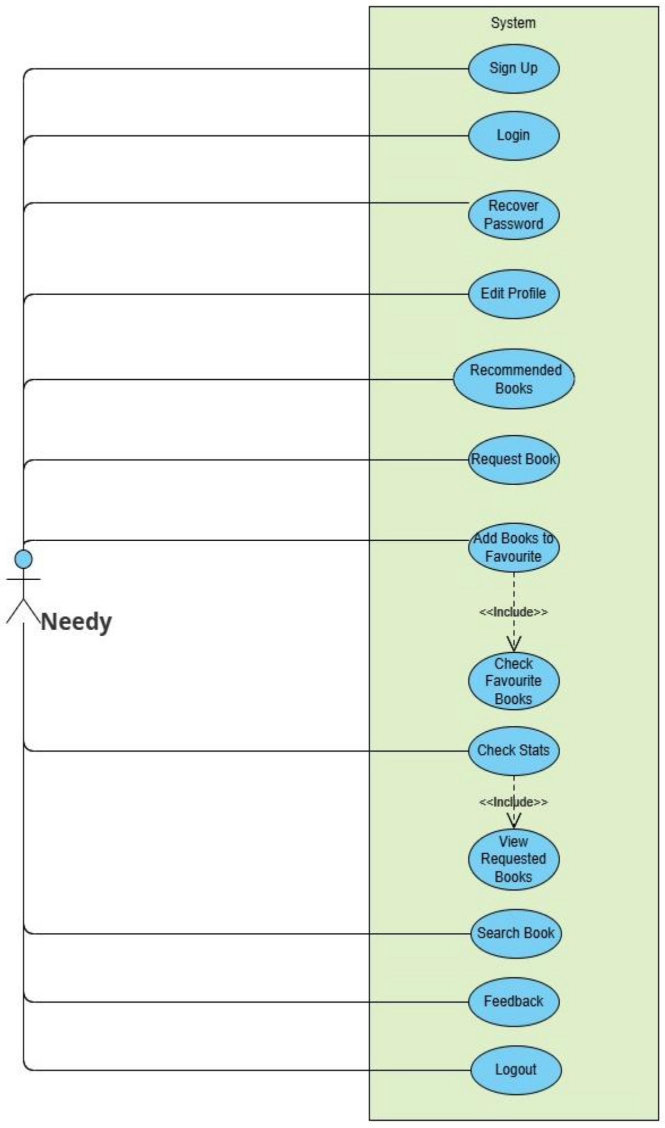


Figure 3.3: Needy Use-Case Diagram

3.5.3 Donor Use-Case Diagram:

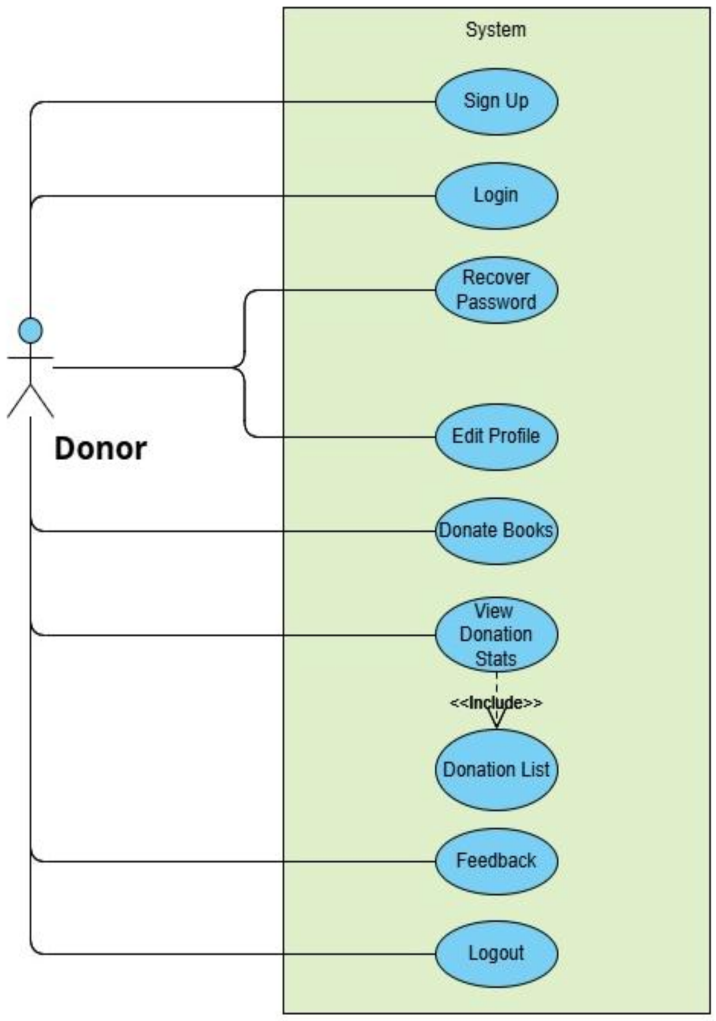


Figure 3.4: Donor Use-Case Diagram

3.5.4 Volunteer Use-Case Diagram

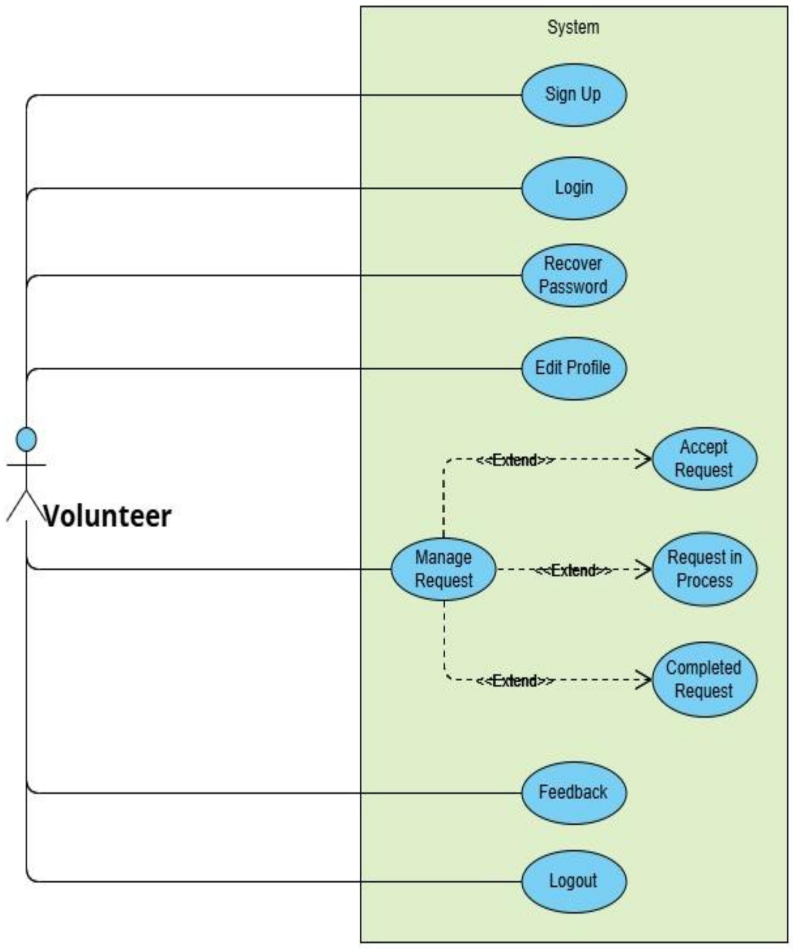


Figure 3.5: Volunteer Use-Case Diagram

3.5.5 Full System Use-Case Diagram:

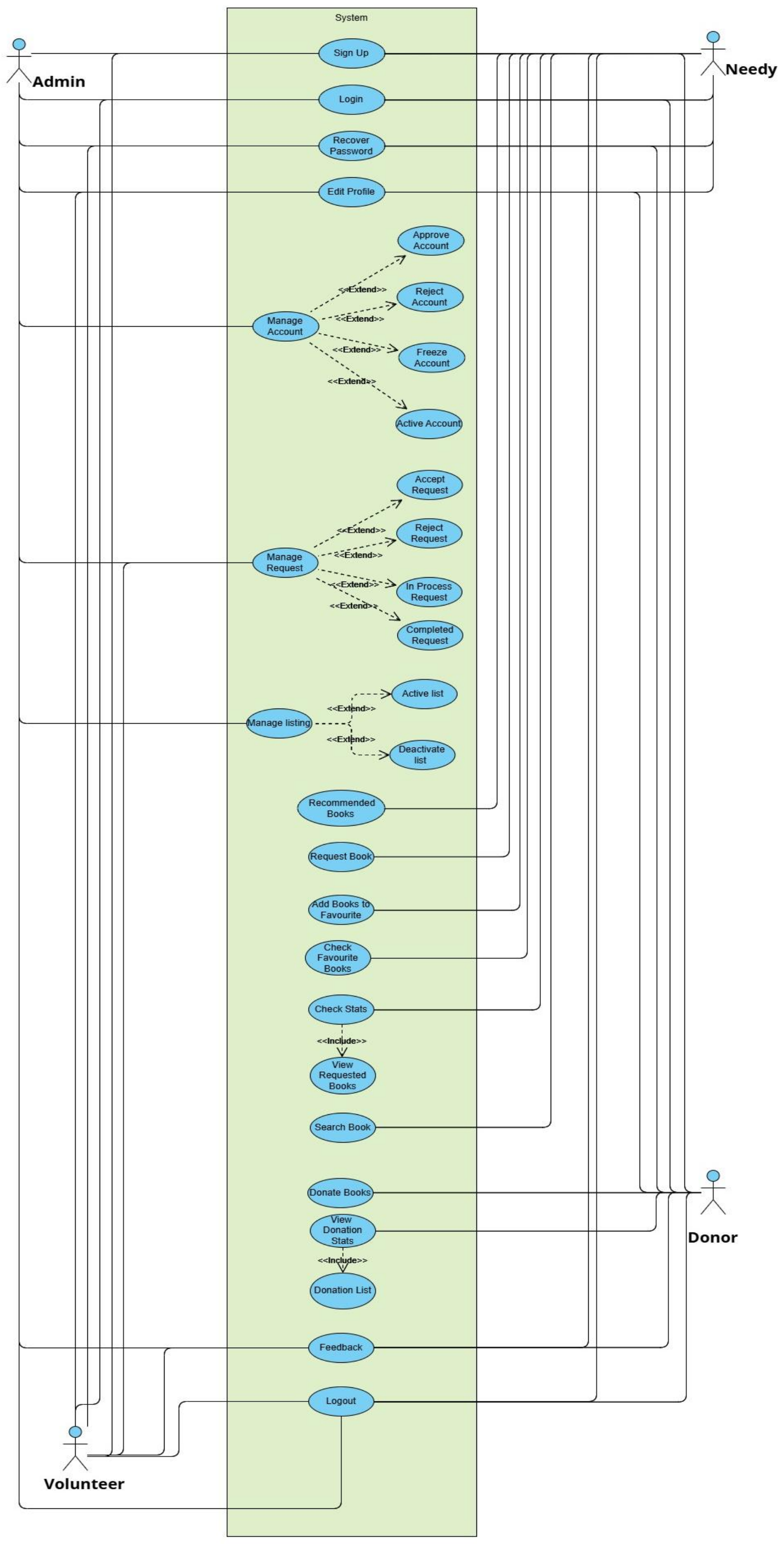


Figure 3.6: Full System Use-Case Diagram

3.6 Fully Dressed Use Cases:

3.6.1 Sign Up:

Table 3.5: Fully Dressed Use Case (Sign Up)

USE CASE ID	**UC-001**
USE CASE NAME	Sign Up
PRIMARY ACTOR	Donor / Needy / Volunteer / Admin
PRECONDITION	User is on the registration page
POSTCONDITION	User account is successfully created
MAIN FLOW	1. User accesses the Sign-Up page 2. Enters required details (name, email, password etc.) 3. Clicks Sign Up 4. System validates input 5. System saves data and creates account 6. User is notified of successful registration
ALTERNATE FLOW	4a. Missing or invalid data: system prompts correction 4b. Email already exists: system notifies and blocks submission

3.6.2 Login

Table 3.6: Fully Dressed Use Case (Login)

USE CASE ID	**UC-002**
USE CASE NAME	Login
PRIMARY ACTOR	Donor / Needy / Volunteer / Admin
PRECONDITION	User is registered and on login screen
POSTCONDITION	User is logged into the system
MAIN FLOW	1. User enters email and password 2. Clicks Login 3. System verifies credentials 4. Redirects to user dashboard
ALTERNATE FLOW	3a. Invalid credentials: system shows error 3b. Account is frozen: system denies access and displays message

3.6.3 Recover password:

Table 3.7: Fully Dressed Use Case (Recover Password)

USE CASE ID	**UC-003**
USE CASE NAME	Recover Password
PRIMARY ACTOR	Donor / Needy / Volunteer / Admin
PRECONDITION	User is on password recovery screen
POSTCONDITION	Forgot Password OTP is sent to user's email
MAIN FLOW	1. User enters registered email 2. Clicks 'Verify Email' 3. System sends OTP via email 4. User resets password via OTP
ALTERNATE FLOW	1a. Email not registered: system notifies user

3.6.4 Edit Profile:

Table 3.8: Fully Dressed Use Case (Edit Profile)

USE CASE ID	**UC-004**
USE CASE NAME	Edit Profile
PRIMARY ACTOR	Donor / Needy / Volunteer / Admin
PRECONDITION	User is logged in and on profile page
POSTCONDITION	Profile is updated
MAIN FLOW	1. User navigates to profile page 2. Edits fields (Email, Profile picture, address etc.) 3. Verify email with OTP 4. Clicks Save 5. System updates database 6. Confirms update to user
ALTERNATE FLOW	4a. Invalid inputs: system prompts correction

3.6.5 Donate Books:

Table 3.9: Fully Dressed Use Case (Donate Books)

USE CASE ID	**UC-005**
USE CASE NAME	Donate Books
PRIMARY ACTOR	Donor
PRECONDITION	Donor is logged in
POSTCONDITION	Donation created successfully.
MAIN FLOW	1. Donor selects 'Switch to donate' 2. Fills form with book details 3. Submits donation 4. System records donation and confirmation by email.
ALTERNATE FLOW	3a. Missing book details: system prompts for completion

3.6.6 Request Book:

Table 3.10: Fully Dressed Use Case (Request Book)

USE CASE ID	**UC-006**
USE CASE NAME	Request Book
PRIMARY ACTOR	Needy
PRECONDITION	Needy is logged in
POSTCONDITION	Book request is submitted
MAIN FLOW	1. See books on Dashboard 2. Selects a book and clicks 'Request' 3. System saves the request 4. Request Confirmation email sent to user
ALTERNATE FLOW	2a. your request has not been submitted you have exceed your limit for this month

3.6.7 Manage Donor Request:

Table 3.11: Fully Dressed Use Case (Manage Donor Request)

USE CASE ID	**UC-007**
USE CASE NAME	Manage Request
PRIMARY ACTOR	Volunteer
PRECONDITION	Volunteer is logged in
POSTCONDITION	Request in process
MAIN FLOW	1. Volunteer views pending requests 2. Accept one to manage 3. Accepted request status will be change to in process
ALTERNATE FLOW	1a. System shows message no data available

3.6.8 Manage Account:

Table 3.12: Fully Dressed Use Case (Manage Account)

USE CASE ID	**UC-007**
USE CASE NAME	Manage Account
PRIMARY ACTOR	Admin
PRECONDITION	Admin is logged in
POSTCONDITION	Account Status is Updated to (approved, Reject, frozen, Active.)
MAIN FLOW	1. Admin views list of pending accounts 2. Approves, rejects, or freezes and active as needed 3. System updates status 4. System send email to user about the account status
ALTERNATE FLOW	1a. System shows message no data available

3.6.9 Manage Listing:

Table 3.13: Fully Dressed Use Case (Manage Listing)

USE CASE ID	**UC-009**
USE CASE NAME	Manage Listing
PRIMARY ACTOR	Admin
PRECONDITION	Admin is logged in
POSTCONDITION	Deactivated Successfully
MAIN FLOW	1. Admin navigates to Active List 2. View active list 3. Chooses Deactivate 4. System update the status of book
ALTERNATE FLOW	3a. No data available

3.6.10 Feedback:

Table 3.14: Fully Dressed Use Case (Feedback)

USE CASE ID	**UC-010**
USE CASE NAME	Feedback
PRIMARY ACTOR	All Users
PRECONDITION	User on landing page
POSTCONDITION	Feedback is Saved Successfully
MAIN FLOW	1. User accesses feedback form 2. Fill feedback form 3. Submit feedback form 3. System saves feedback
ALTERNATE FLOW	2a. If any field empty, system prompts appear “fields are required”

3.6.11 Recommended Books:

Table 3.15: Fully Dressed Use Case (Recommended Books)

USE CASE ID	**UC-011**
USE CASE NAME	Recommended Books
PRIMARY ACTOR	Needy
PRECONDITION	Needy Must be logged in
POSTCONDITION	Needy can request book and add to favorite
MAIN FLOW	1. User will view recommended books on dashboard
ALTERNATE FLOW	

3.6.12 Add to Favorites:

Table 3.16: Fully Dressed Use Case (Add to Favorites)

USE CASE ID	**UC-012**
USE CASE NAME	Add to Favorites
PRIMARY ACTOR	Needy
PRECONDITION	Needy must be Logged in and on Dashboard
POSTCONDITION	Book added to favorites
MAIN FLOW	1. User will view available books on dashboard 2. User will click on like button 3. Book will be added to favorites
ALTERNATE FLOW	1a. No Available Books

3.6.13 Requested Book Statistics:

Table 3.17: Fully Dressed Use Case (Requested Book Statistics)

USE CASE ID	**UC-013**
USE CASE NAME	Requested Book Statistics
PRIMARY ACTOR	Needy
PRECONDITION	Needy Should be on profile page
POSTCONDITION	View request book
MAIN FLOW	1. Needy clicks to profile page 2. Needy view requested books statistics 3. Clicks on requested books 4. View all requested book details
ALTERNATE FLOW	4a. No book requested

3.6.14 Search Book:

Table 3.18: Fully Dressed Use Case (Search Book)

USE CASE ID	**UC-014**
USE CASE NAME	Search Book
PRIMARY ACTOR	Needy
PRECONDITION	Needy must be on the dashboard
POSTCONDITION	Searched books will be displayed
MAIN FLOW	1. Needy accesses the dashboard 2. Needy enters book title in the search bar 3. System fetches matching books from the database 4. System displays the list of books that matches the title.
ALTERNATE FLOW	3a. If no match is found, system displays “No books found”

3.6.15 Donated Book Statistics:

Table 3.19: Fully Dressed Use Case (Donated Book Statistics)

USE CASE ID	**UC-015**
USE CASE NAME	Donated Book Statistics
PRIMARY ACTOR	Donor
PRECONDITION	Donor Should be on Profile page
POSTCONDITION	View donated books
MAIN FLOW	1. Donor clicks on profile page 2. Donor view donated book statistics 3. Clicks on donated books 4. View all donated books
ALTERNATE FLOW	4a. No donated books found

3.6.16 Manage Request:

Table 3.20: Fully Dressed Use Case (Manage Request)

USE CASE ID	UC-016
USE CASE NAME	Manage Request
PRIMARY ACTOR	Admin
PRECONDITION	Admin must be logged in
POSTCONDITION	Request status will be updated to either **Accepted**, **Rejected**, or **Completed**
MAIN FLOW	1. Admin logs in and navigates to the Dashboard 2. Admin clicks on "Manage Requests" tab 3. System displays all pending book requests 4. Admin selects a request 5. Admin updates the request status (Accepted/Rejected/Completed) 6. System updates the request status in the database
ALTERNATE FLOW	3a. If no requests are available, system shows message: “No data available”

3.6.17 Logout:

Table 3.21: Fully Dressed Use Case (Logout)

USE CASE ID	**UC-017**
USE CASE NAME	Logout
PRIMARY ACTOR	Admin / Donor / Volunteer / Needy
PRECONDITION	All user must be Logged in
POSTCONDITION	Logout Successfully
MAIN FLOW	1. User is on dashboard 2. Clicks on profile picture or dropdown 3. Selects "Logout" from the menu 4. System terminates session and redirects to login screen
ALTERNATE FLOW	

3.7 Entity Relationship diagram

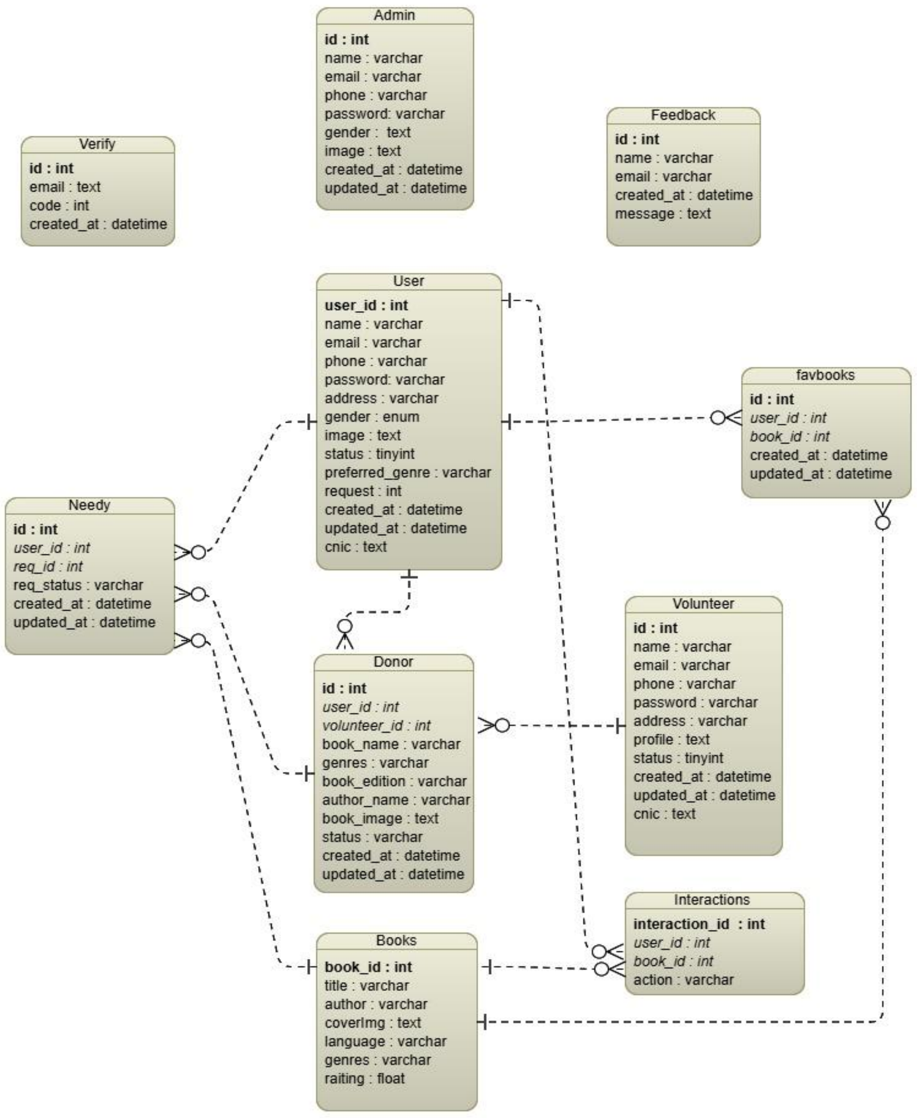


Figure 3.7: Entity Relationship Diagram (ERD)

3.8 Activity Diagram

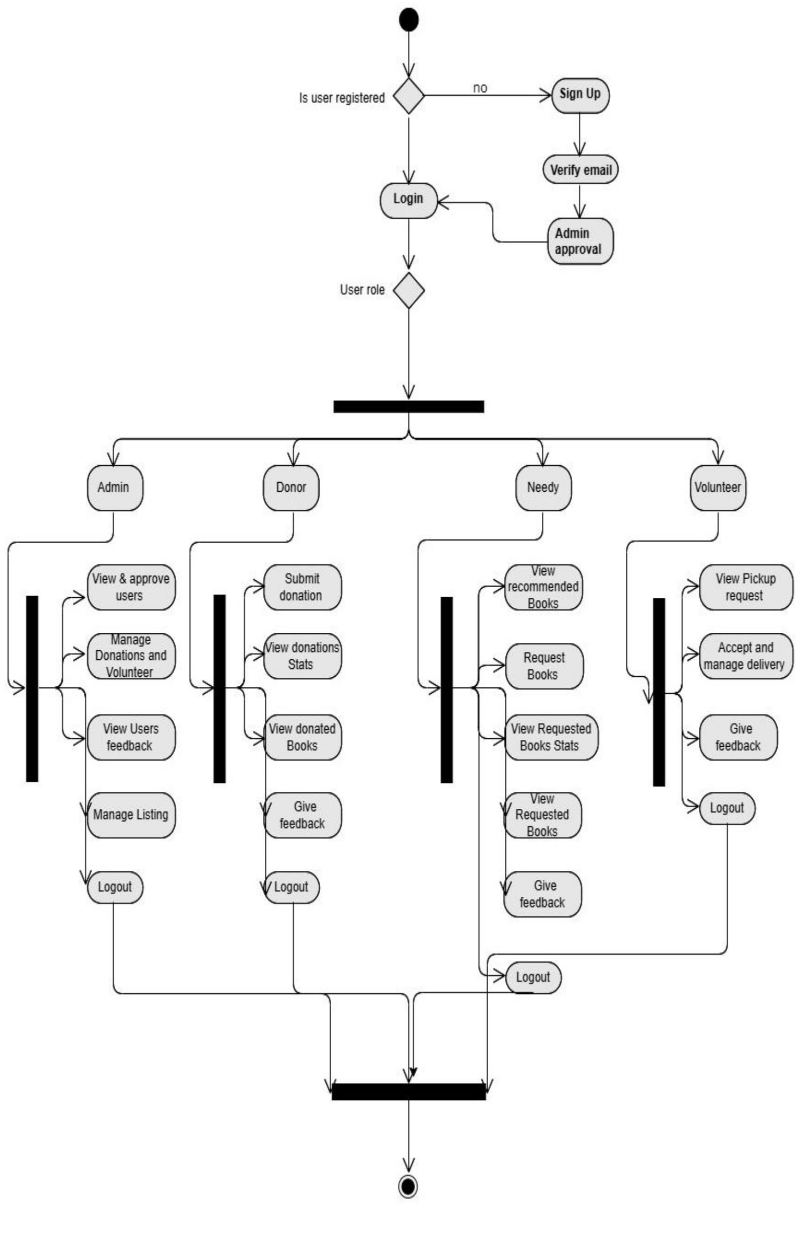
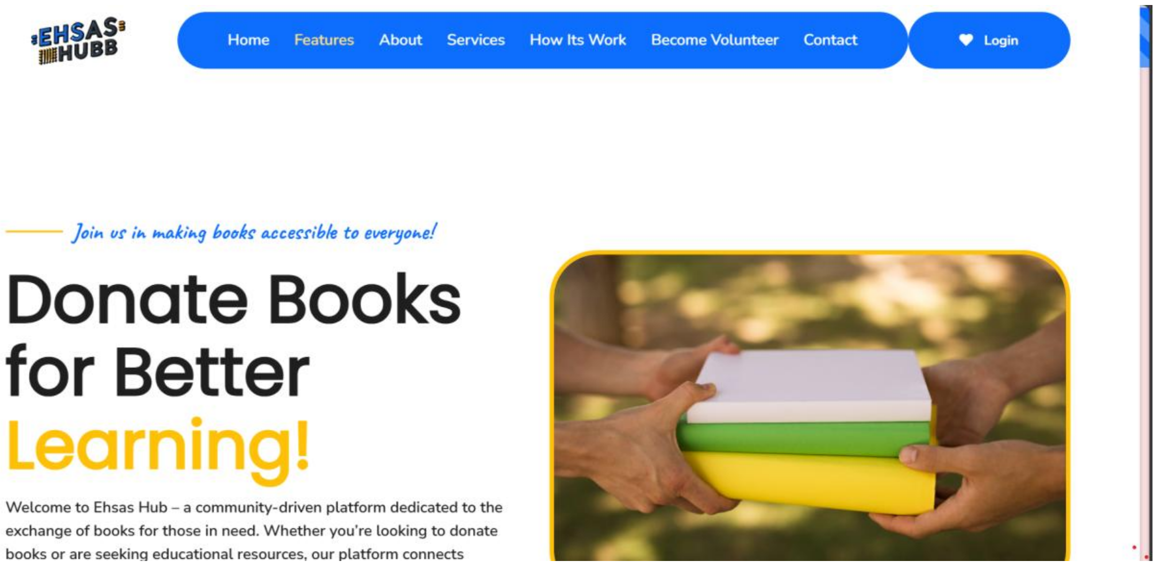


Figure 3.8: Whole system Activity Diagram

3.9 GUI Graphical User Interfaces

3.9.1 User Role GUI:

- This is the landing page of Ehsas-hub website.

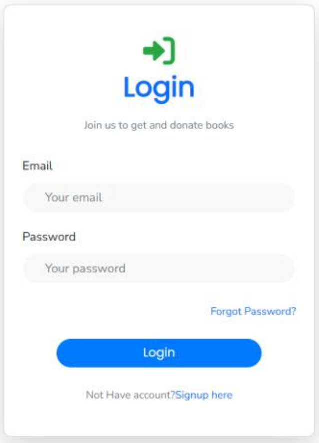


Join us in making books accessible to everyone!

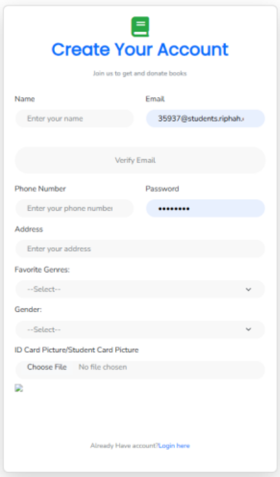
Donate Books for Better Learning!

Welcome to Ehsas Hub – a community-driven platform dedicated to the exchange of books for those in need. Whether you're looking to donate books or are seeking educational resources, our platform connects

- Login page for user (Needy/Donor).



- Sign up for user (Needy/Donor). User will fill this form and verify its provided email after that he can submit this signup request for approval.



Create Your Account

Join us to get and donate books

Name: Enter your name

Email: 35937@students.riphah.

Verify Email

Phone Number: Enter your phone number

Password: ••••••••

Address: Enter your address

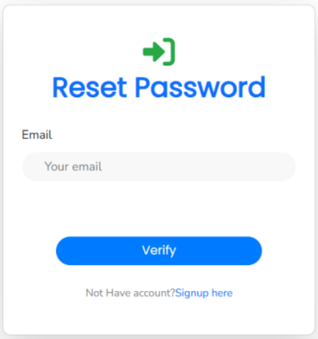
Favorite Genres: --Select--

Gender: --Select--

ID Card Picture/Student Card Picture: Choose File No file chosen

Already Have account?Login here

- Password reset page for all user (Needy/Donor/Volunteer/Admin).
- Email will be required and a code will appear in email.
- After entering the correct code, set new password and click the reset button and new password will be saved.

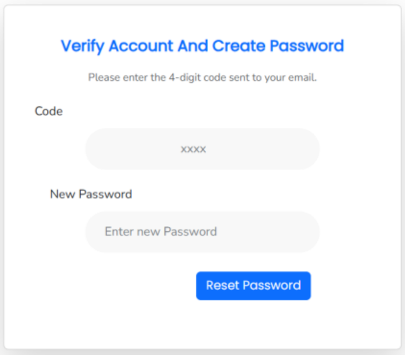


Reset Password

Email: Your email

Verify

Not Have account?Signup here


Verify Account And Create Password

Please enter the 4-digit code sent to your email.

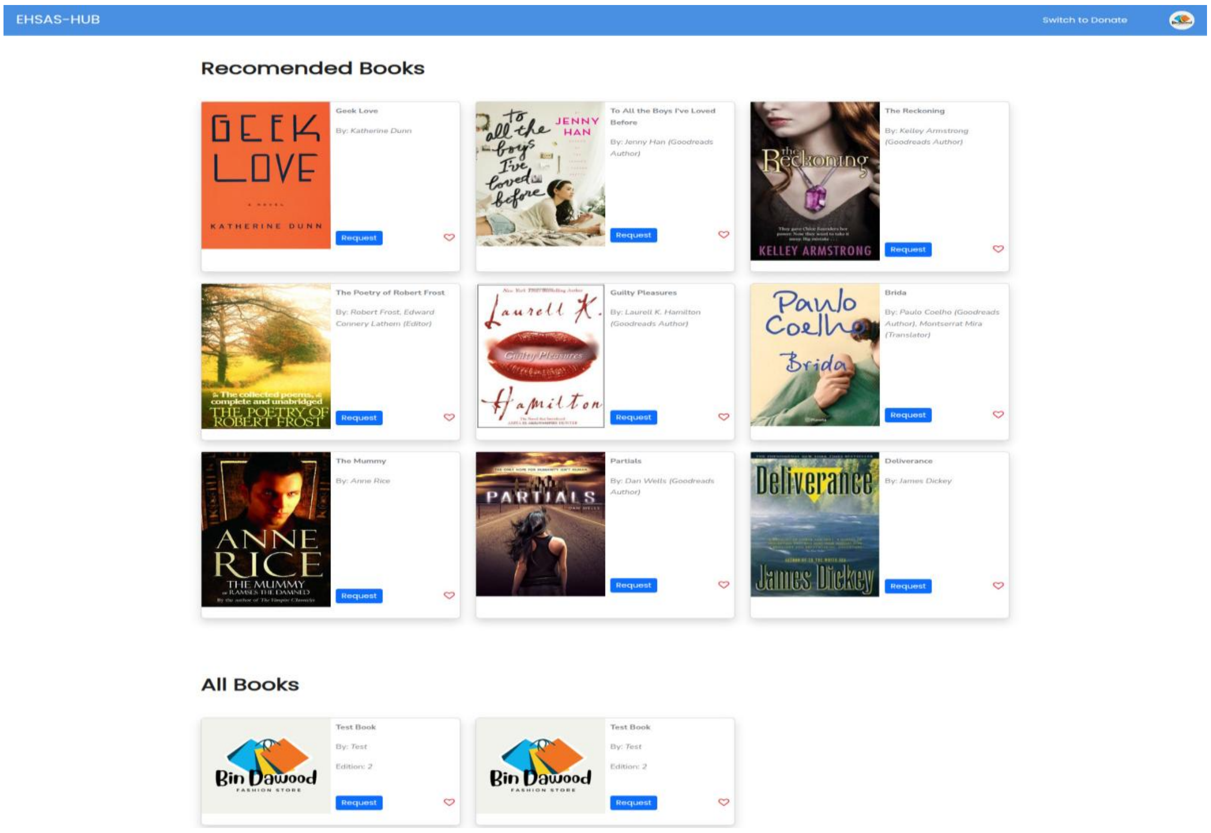
Code

xxxx

New Password

Enter new Password

- This is user (Needy/Donor) dashboard.
- Books recommended by model according to preferred genre and all books available on Ehsas-hub will be shown to user.
- If user want to donate any book, he will select switch to donate and a form will appear for donation.



Recomended Books

Geek Love
By: Katherine Dunn

To All the Boys I've Loved Before
By: Jenny Han (Goodreads Author)

The Reckoning
By: Kelley Armstrong (Goodreads Author)

The Poetry of Robert Frost
By: Robert Frost, Edward Connery Lathem (Editor)

Guilty Pleasures
By: Laurell K. Hamilton (Goodreads Author)

Brida
By: Paulo Coelho (Goodreads Author), Montserrat Mira (Translator)

The Mummy
By: Anne Rice

Partials
By: Dan Wells (Goodreads Author)

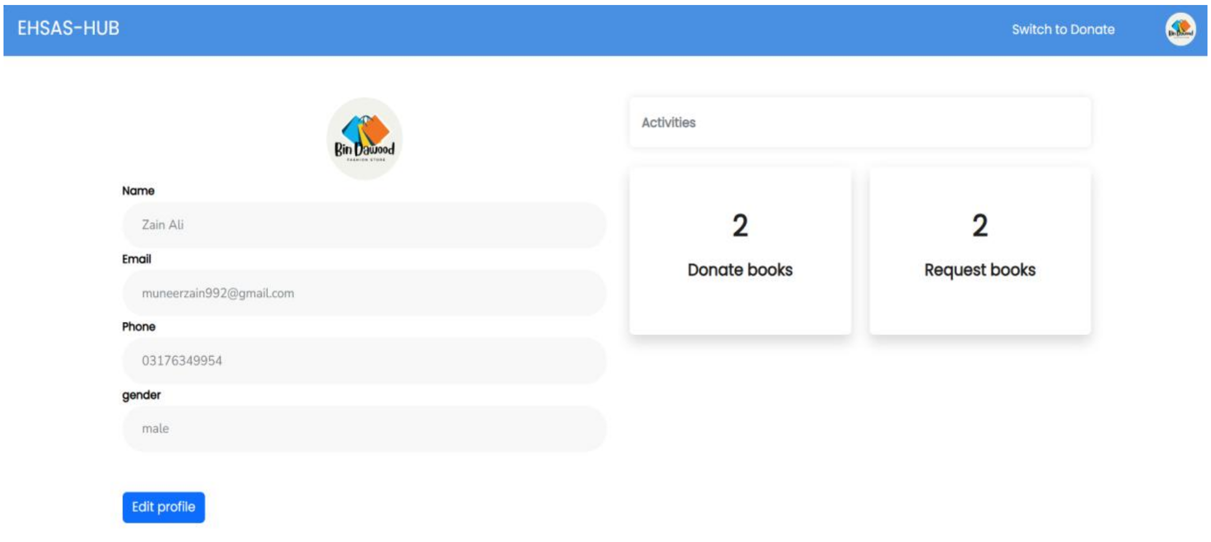
Deliverance
By: James Dickey

All Books

Test Book
By: Test
Edition: 2

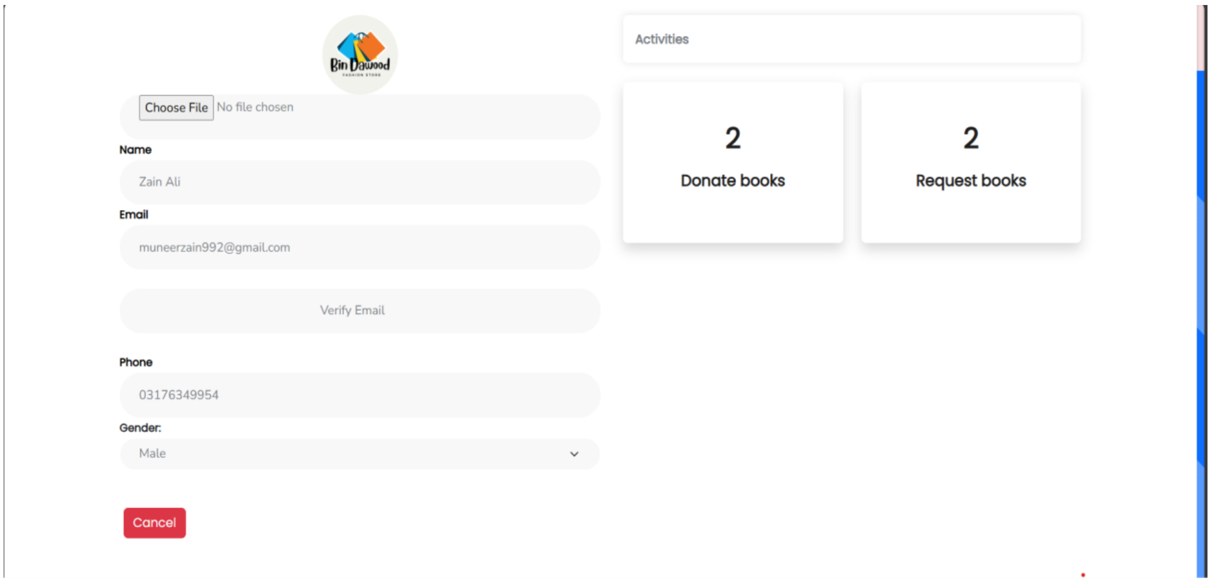
Test Book
By: Test
Edition: 2

- This is user (Needy/Donor) profile view.
- User can edit profile but every time he will verify register email first then can update its profile.
- View total books donated and requested with details.



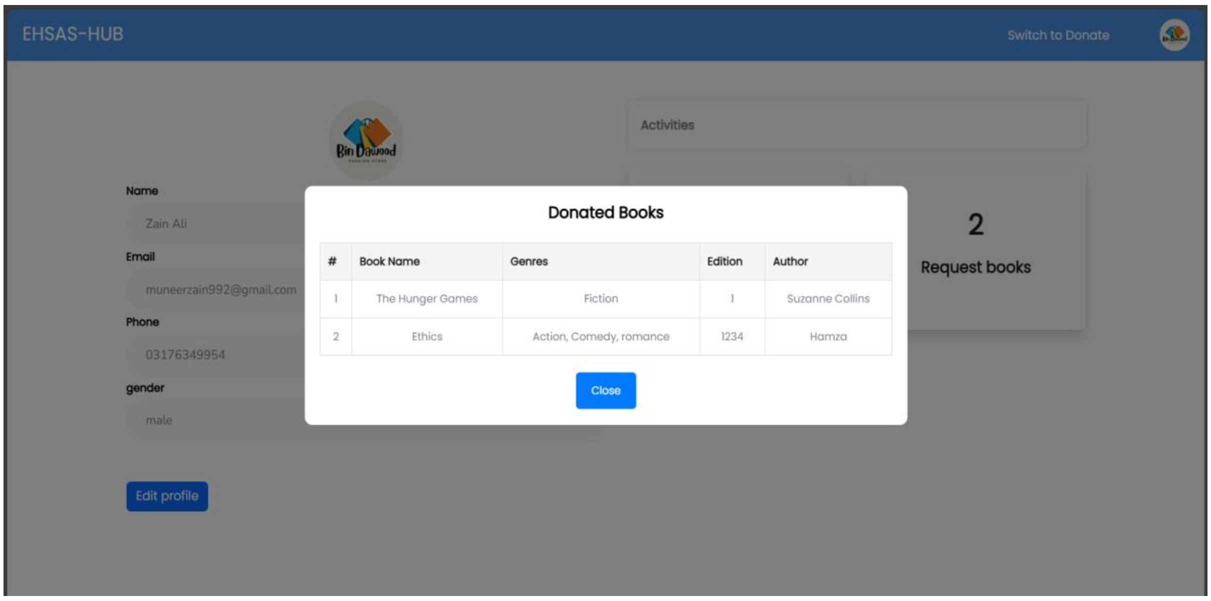
Name: Zain Ali
Email: muneerzain992@gmail.com
Phone: 03176349954
gender: male

2 Donate books
2 Request books



No file chosen
Name: Zain Ali
Email: muneerzain992@gmail.com
Phone: 03176349954
Gender: Male

2 Donate books
2 Request books



Name

Zain Ali

Email

muneerzain992@gmail.com

Phone

03176349954

gender

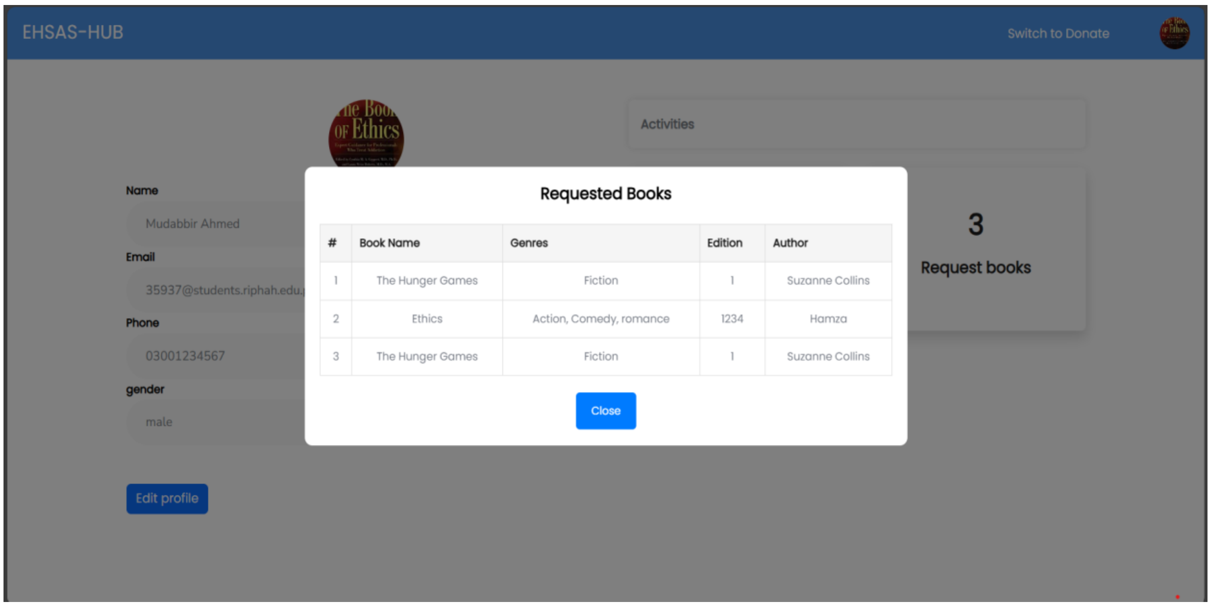
male

2

Request books

Donated Books

#	Book Name	Genres	Edition	Author
1	The Hunger Games	Fiction	1	Suzanne Collins
2	Ethics	Action, Comedy, romance	1234	Hamza



Name

Mudabbir Ahmed

Email

35937@students.riphah.edu.

Phone

03001234567

gender

male

3

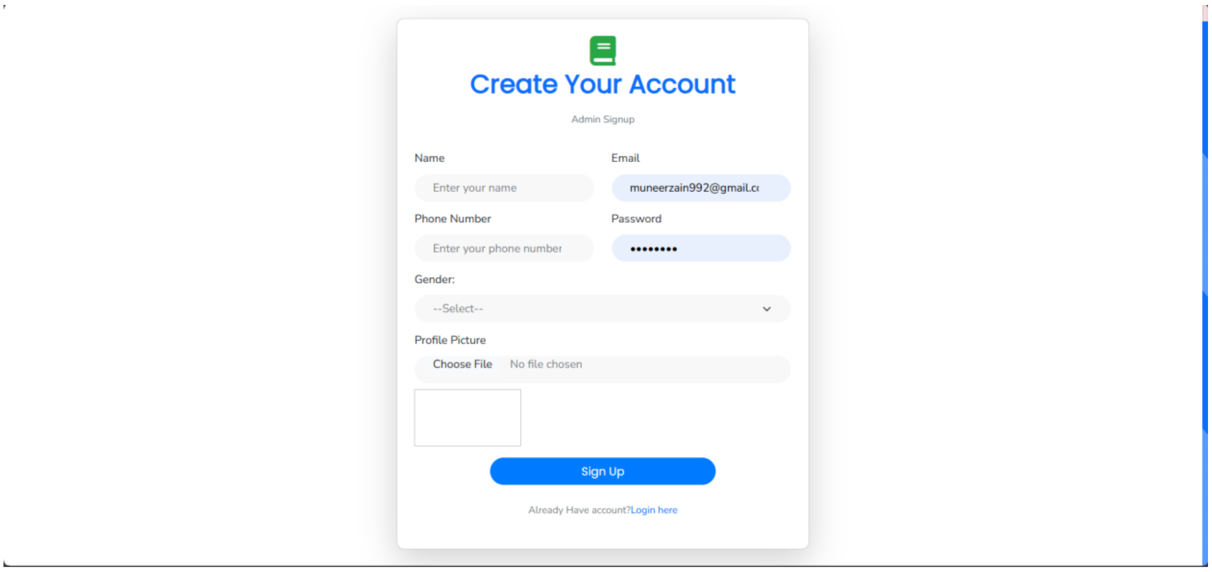
Request books

Requested Books

#	Book Name	Genres	Edition	Author
1	The Hunger Games	Fiction	1	Suzanne Collins
2	Ethics	Action, Comedy, romance	1234	Hamza
3	The Hunger Games	Fiction	1	Suzanne Collins

3.9.2 Admin Role GUI:

- Admin Sign up/login page



Create Your Account

Admin Signup

Name: Enter your name

Email: muneerzain992@gmail.cc

Phone Number: Enter your phone number

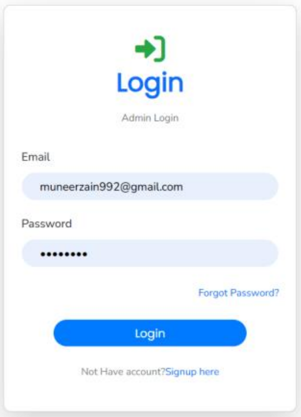
Password: ••••••••

Gender: --Select--

Profile Picture: Choose File No file chosen

Sign Up

Already Have account?Login here



Login

Admin Login

Email: muneerzain992@gmail.com

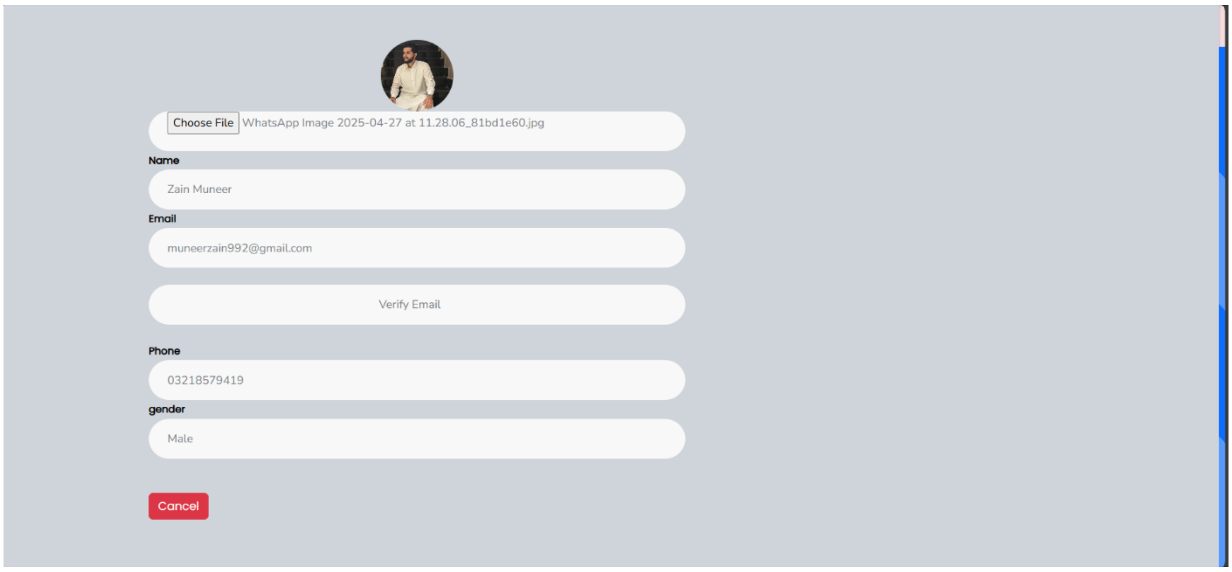
Password: ••••••••

Forgot Password?

Login

Not Have account?Signup here

- Admin profile view Page



Choose File WhatsApp Image 2025-04-27 at 11.28.06_81bd1e60.jpg

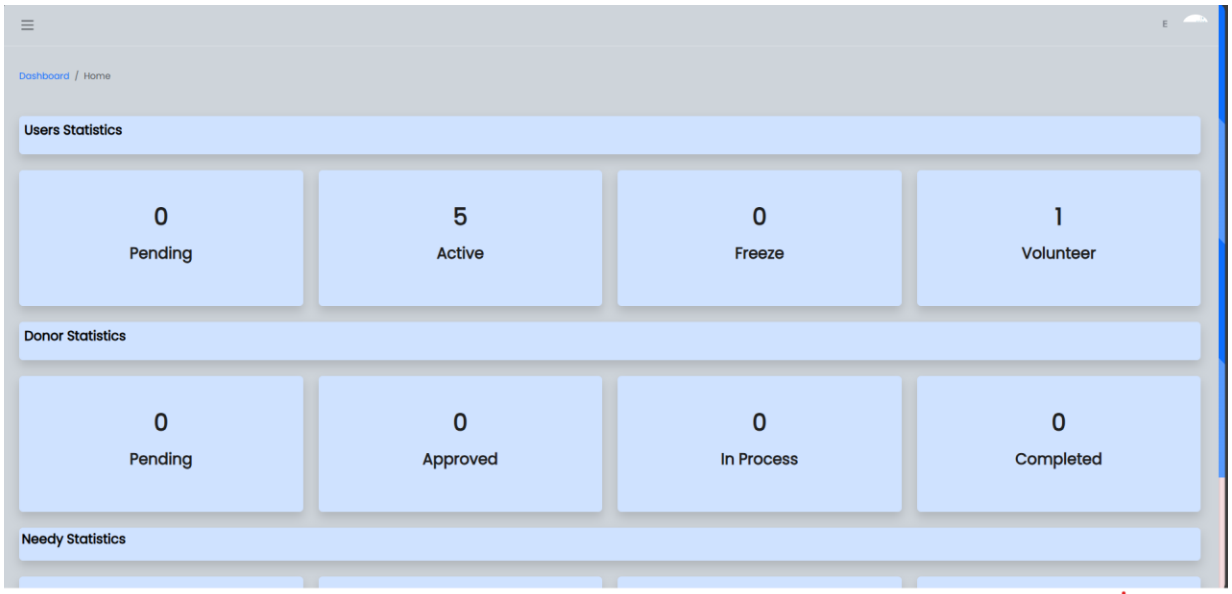
Name: Zain Muneer

Email: muneerzain992@gmail.com

Phone: 03218579419

gender: Male

- Admin Statistic page for all users activities



Dashboard / Home

Users Statistics

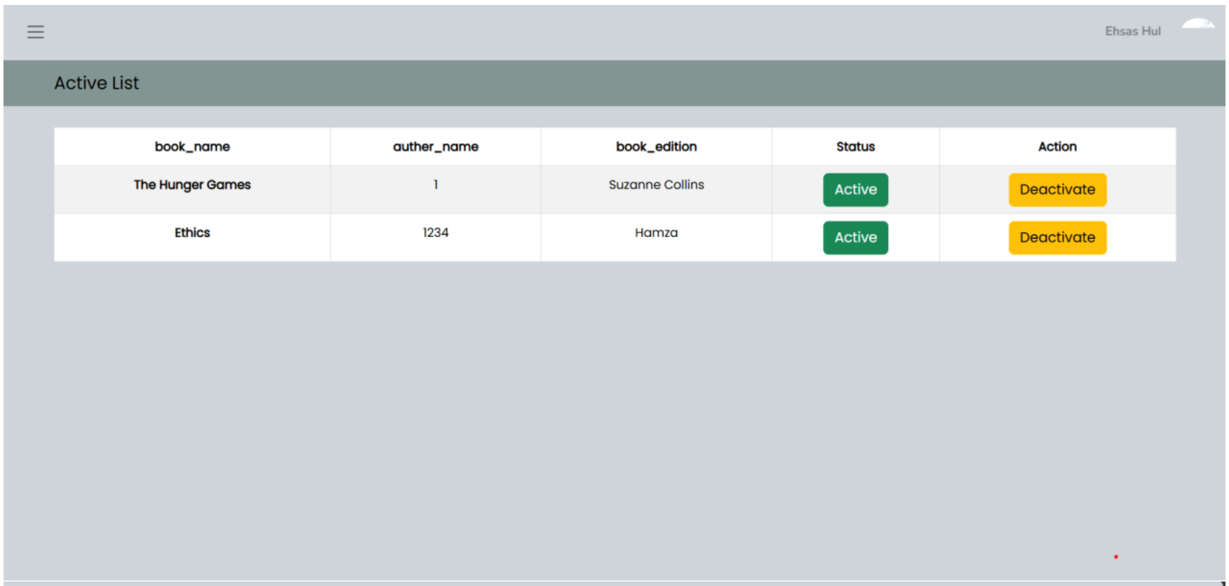
0	5	0	1
Pending	Active	Freeze	Volunteer

Donor Statistics

0	0	0	0
Pending	Approved	In Process	Completed

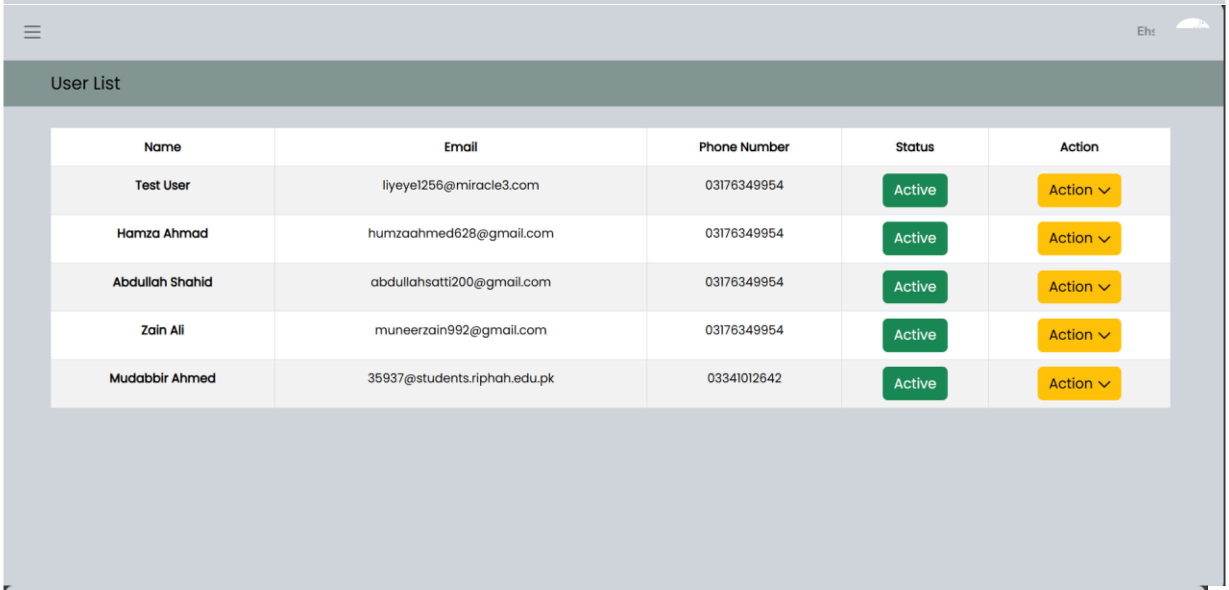
Needy Statistics

- Active user/book/volunteer list page



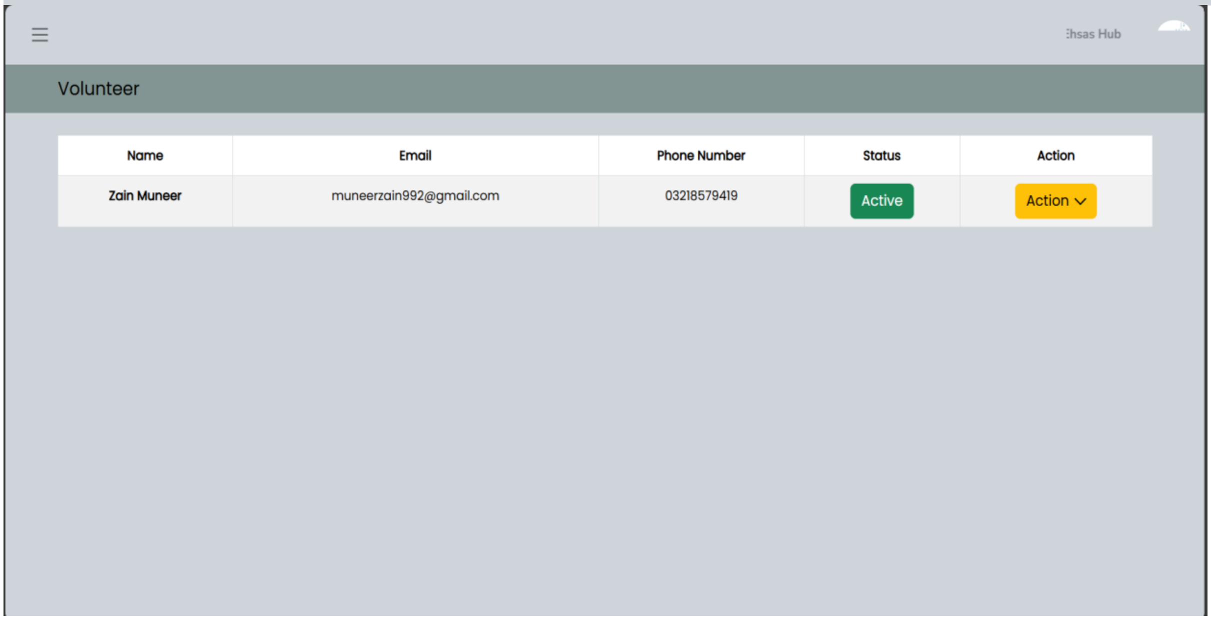
Active List

book_name	auther_name	book_edition	Status	Action
The Hunger Games	1	Suzanne Collins	Active	Deactivate
Ethics	1234	Hamza	Active	Deactivate



User List

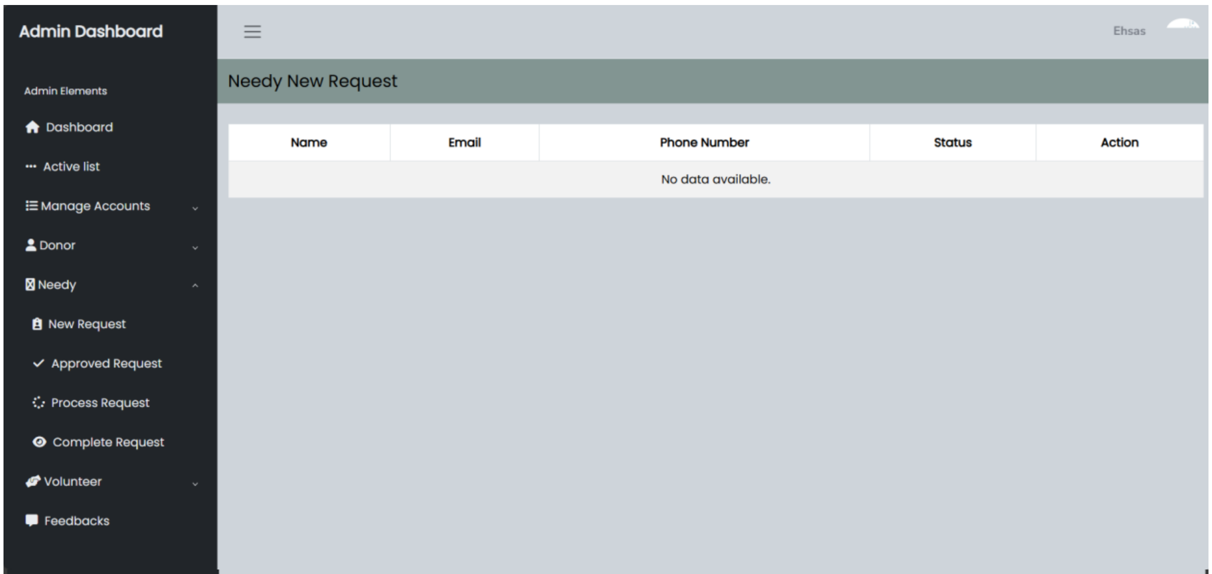
Name	Email	Phone Number	Status	Action
Test User	liyeyel256@miracle3.com	03176349954	Active	Action
Hamza Ahmad	humzaahmed628@gmail.com	03176349954	Active	Action
Abdullah Shahid	abdullahsatti200@gmail.com	03176349954	Active	Action
Zain Ali	muneerzain992@gmail.com	03176349954	Active	Action
Mudabbir Ahmed	35937@students.riphah.edu.pk	03341012642	Active	Action



Volunteer

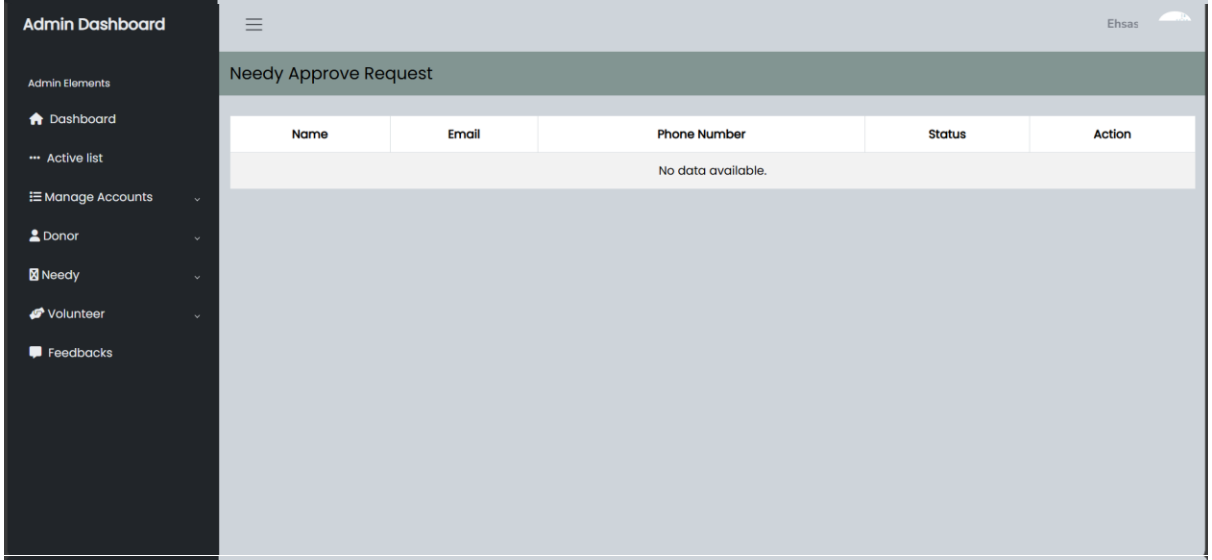
Name	Email	Phone Number	Status	Action
Zain Muneer	muneerzain992@gmail.com	03218579419	Active	Action

- Needy new/inprocess/approved/completed request



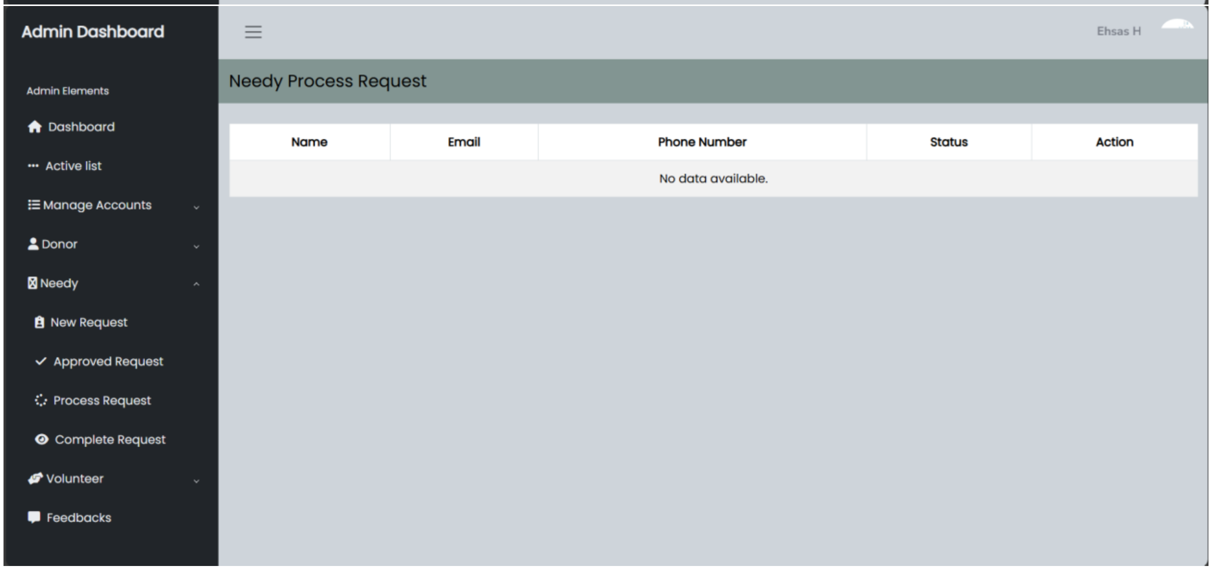
Needy New Request

Name	Email	Phone Number	Status	Action
No data available.				



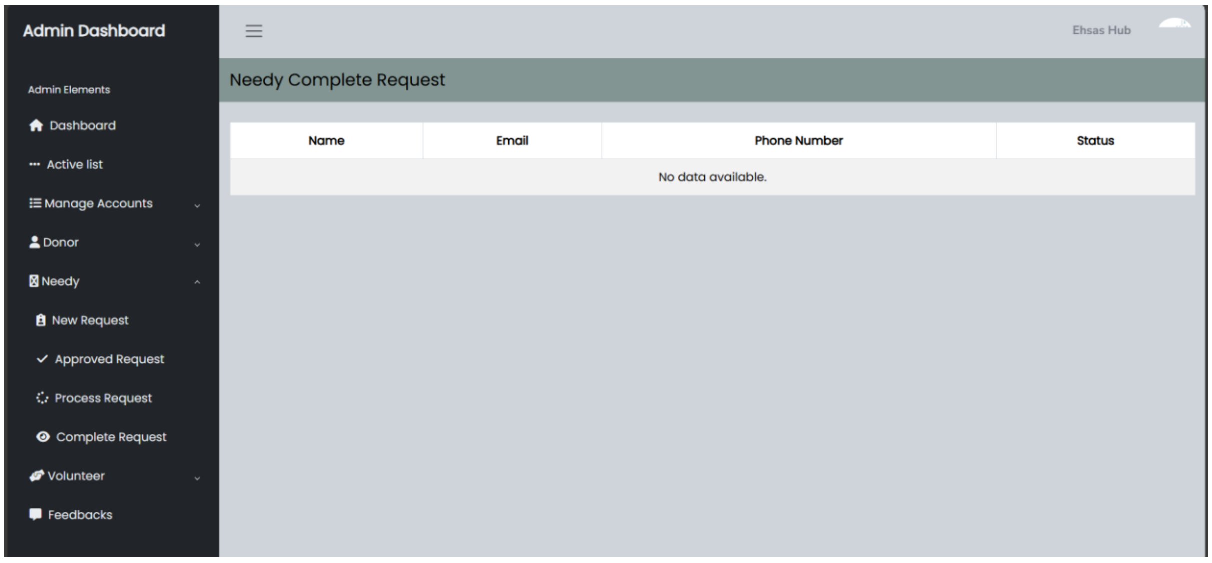
Needy Approve Request

Name	Email	Phone Number	Status	Action
No data available.				



Needy Process Request

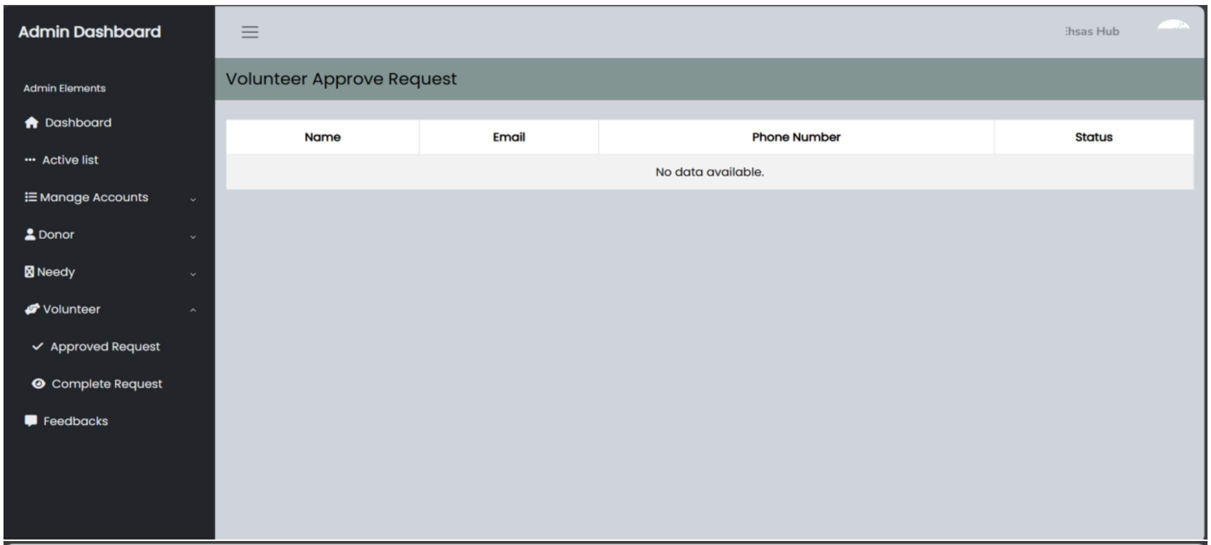
Name	Email	Phone Number	Status	Action
No data available.				



Needy Complete Request

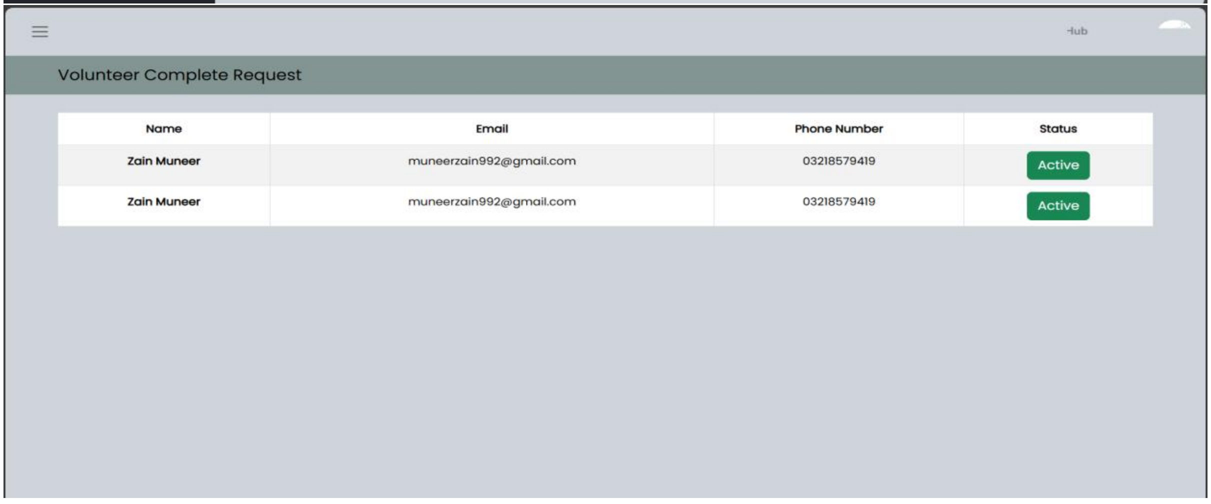
Name	Email	Phone Number	Status
No data available.			

- Volunteer Approved/completed request page.



Volunteer Approve Request

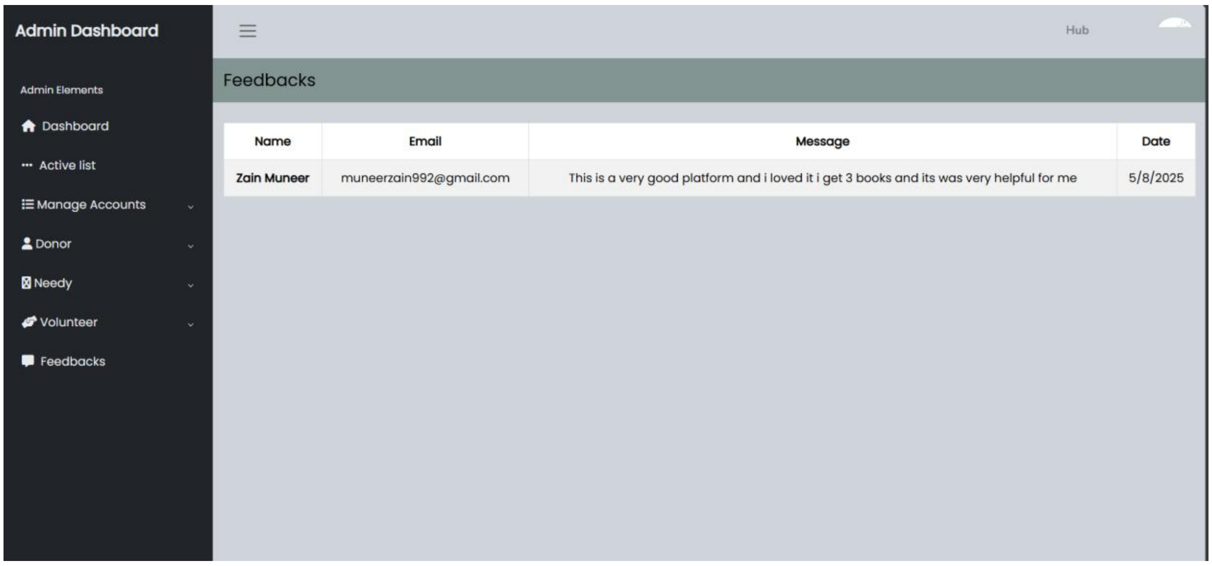
Name	Email	Phone Number	Status
No data available.			



Volunteer Complete Request

Name	Email	Phone Number	Status
Zain Muneer	muneerzain992@gmail.com	03218579419	Active
Zain Muneer	muneerzain992@gmail.com	03218579419	Active

- Feedbacks from user

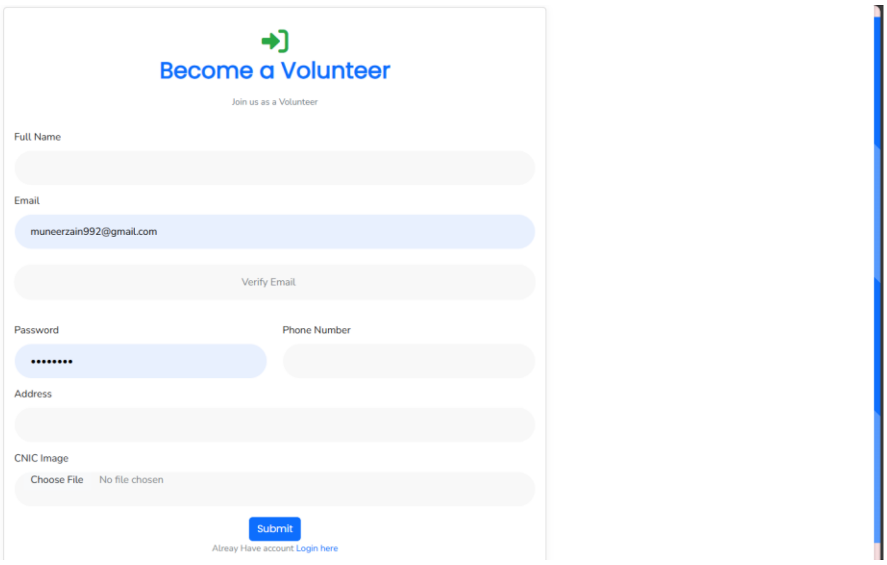


Feedbacks

Name	Email	Message	Date
Zain Muneer	muneerzain992@gmail.com	This is a very good platform and i loved it i get 3 books and its was very helpful for me	5/8/2025

3.9.3 Volunteer Role GUI:

- Volunteer Sign up page.

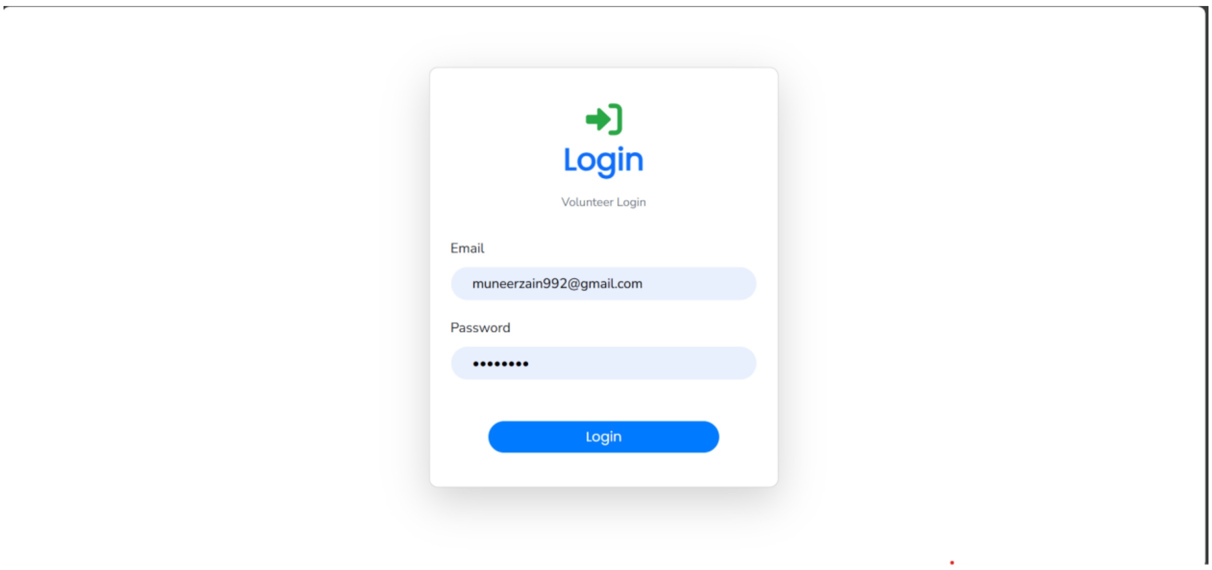


Become a Volunteer

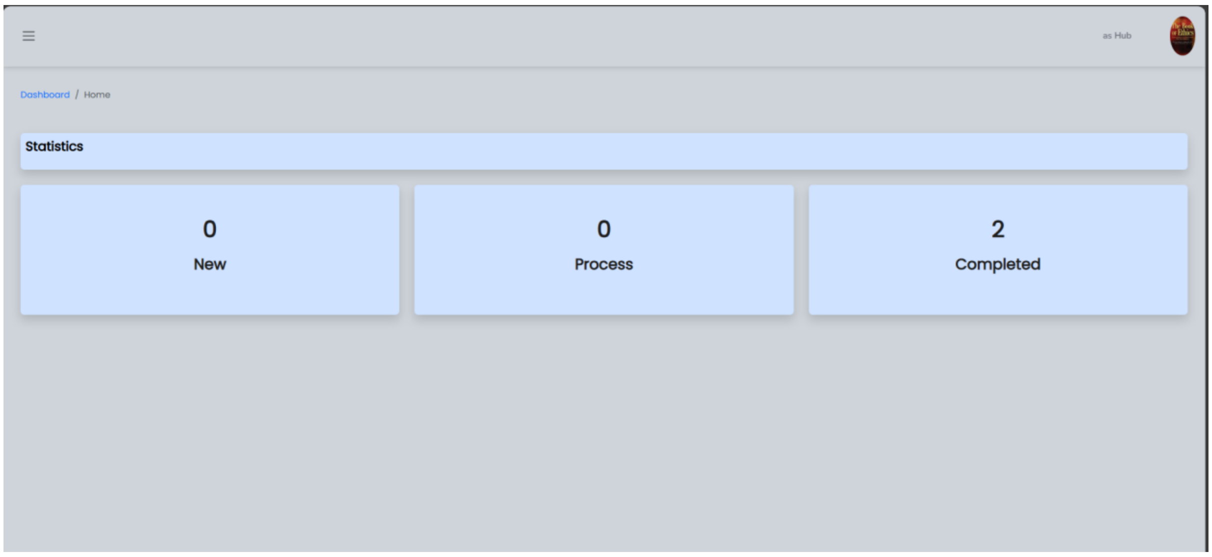
Join us as a Volunteer

Full Name	
Email	muneerzain992@gmail.com
Password	••••••••
Phone Number	
Address	
CNIC Image	Choose File No file chosen

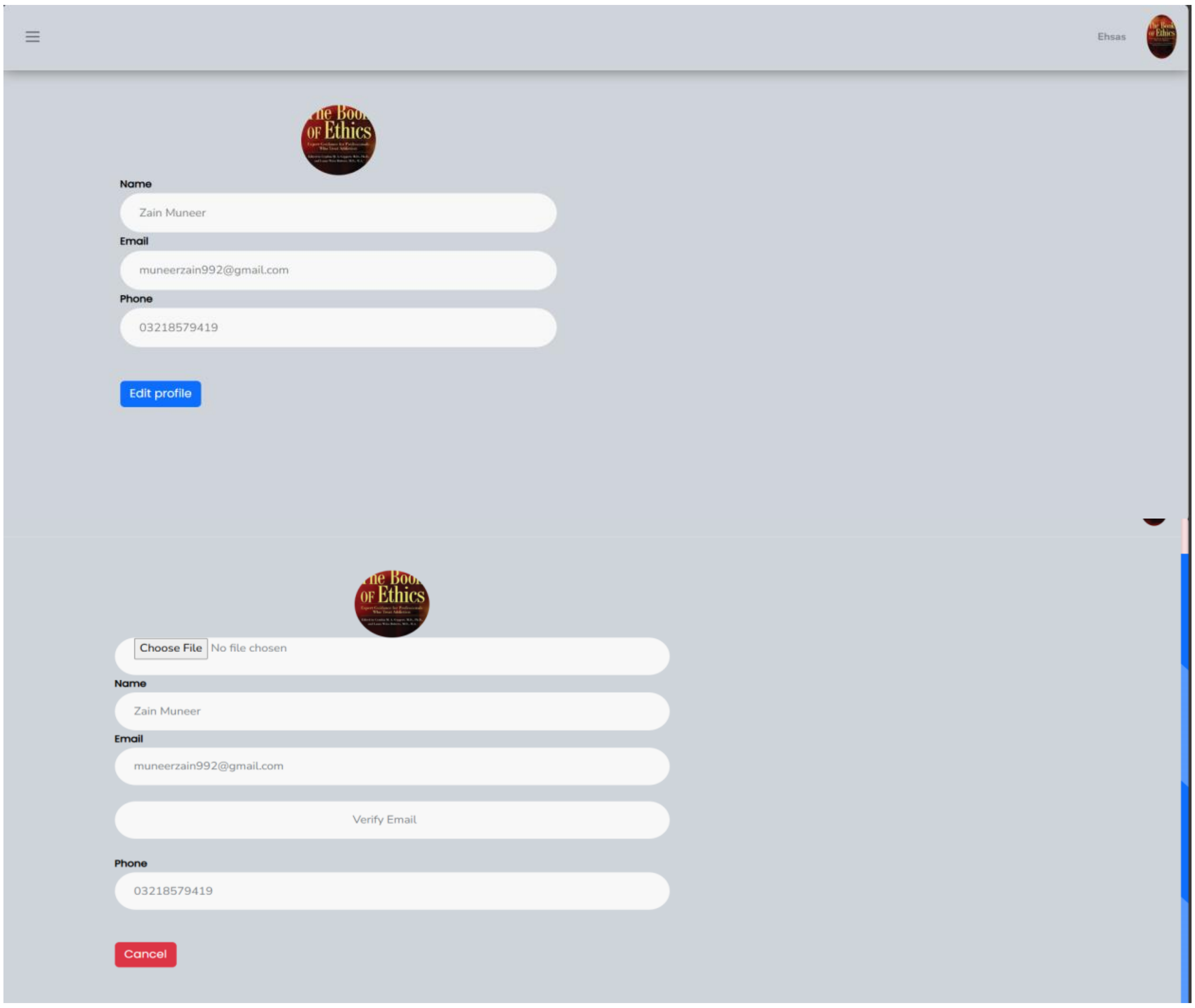
- Volunteer Login Page



- Volunteer Statistics Page.



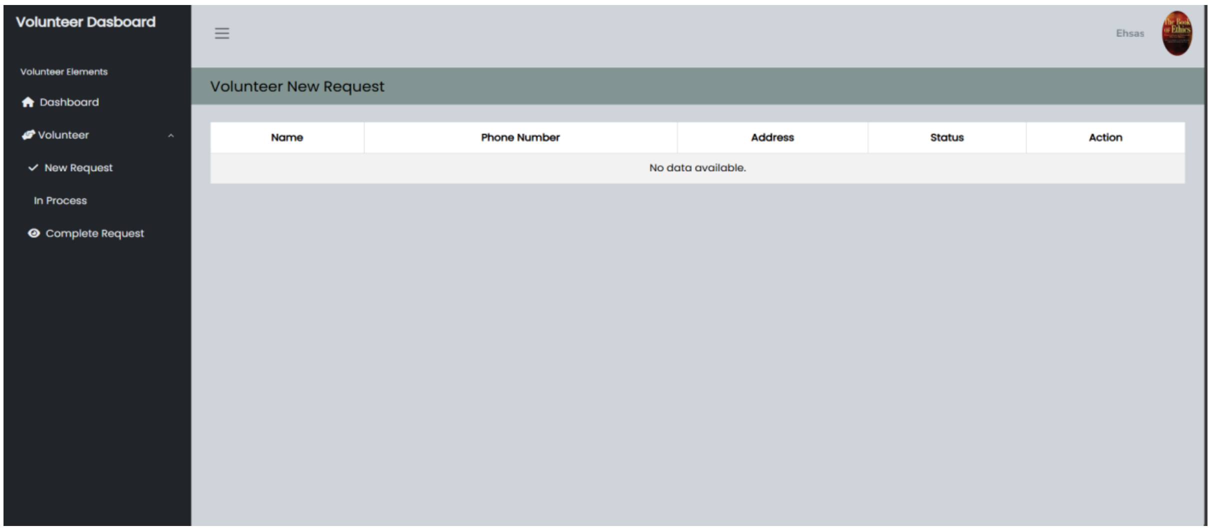
- Volunteer Profile view/edit page.



Name: Zain Muneer
Email: muneerzain992@gmail.com
Phone: 03218579419

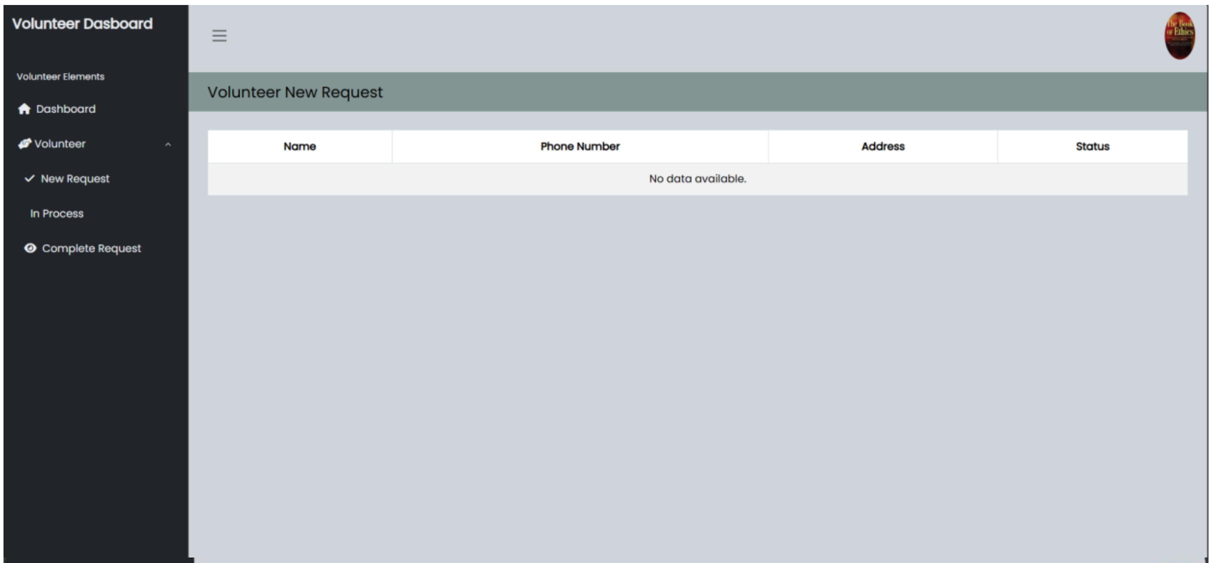
Name: Zain Muneer
Email: muneerzain992@gmail.com
Phone: 03218579419

- Volunteer new/in-process/Completed Request page.



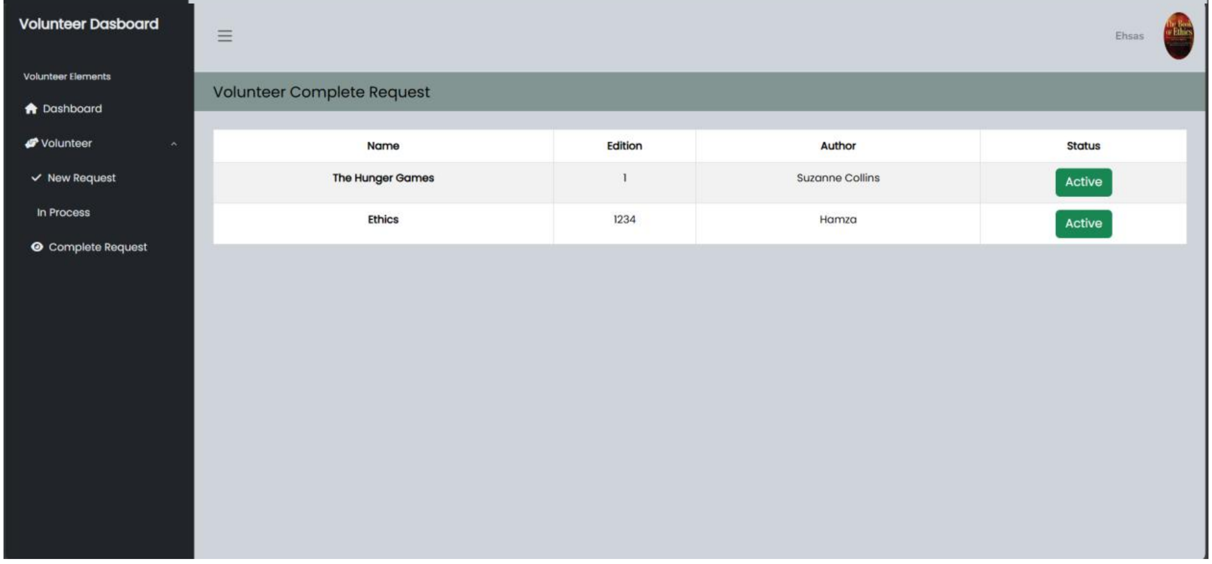
Volunteer New Request

Name	Phone Number	Address	Status	Action
No data available.				



Volunteer New Request

Name	Phone Number	Address	Status
No data available.			



Volunteer Complete Request

Name	Edition	Author	Status
The Hunger Games	1	Suzanne Collins	Active
Ethics	1234	Hamza	Active

Chapter 04:

Implementation and Test Cases

Chapter 4: Implementation and Test Cases

4.1 Implementation

4.1.1 Implementation Overview

Ehsas Hub implemented using the MySQL database through XAMPP server for local development, along with Express.js, React.js, and Node.js for backend and frontend development. The AI recommendation system built in Python using Flask. The system integrates multiple roles—donors, (needy), volunteers, and admins—with functionalities like book donation/request, OTP-based authentication, recommendation engine, and profile verification. This project implements a hybrid recommendation system that leverages both collaborative filtering using deep learning (Neural Collaborative Filtering - NCF) and content-based filtering (genre clustering with BERT embeddings). The system recommends books to users based on their interactions with books and their preferred genres. It is exposed through a Flask API and interacts with data stored in a MySQL database.

4.1.2 Introduction

In this chapter, we delve into the implementation of the **Ehsas-Hub** platform. We will cover the core components of the system that have been developed so far, focusing on the major algorithms implemented, such as the **Recommendation System**, and **Volunteer Coordination** functionalities. Additionally, we will describe the platforms, APIs, and libraries that were used in the system. This chapter will also discuss the test cases that validate the system's functionality, ensuring its performance, security, and reliability.

4.1.3 Prototype

The initial prototype of **Ehsas-Hub** has been developed to display the core functionalities of the platform. This prototype focuses on the primary use cases, such as user registration, book donation management, and personalized recommendations. It provides a basic structure for the system's user interface, backend logic, and database integration, demonstrating how different user roles (students, donors, volunteers, and admins) interact with the platform.

The prototype is built using the (**MySQL**, **Express.js**, **React.js**, and **Node.js**) and integrates key features like a hybrid recommendation system and volunteer task coordination.

4.1.4 Key Implementation Components

4.1.4.1 Frontend (React.js):

- **User Interfaces:** Dynamic views for different roles.
- **Routing:** Implemented using React Router DOM.
- **HTTP Requests:** Axios used for connecting frontend to backend APIs.

4.1.4.2 Form Validation:

- Passwords must include at least 8 characters, one uppercase, one lowercase, and one numeric digit
- All fields must be filled. Any missing field will trigger an error message.
- Book donation/request forms validate genre, edition (numeric only), image format (JPG/PNG only), and title length (minimum 3 characters).

4.1.4.3 Backend (Node.js & Express.js):

- RESTful APIs for login, registration, book management, and volunteering.
- Authentication: JWT and bcrypt for token-based secure login.
- Email Services: Node mailer for OTP email verifications.
- Profile Control: OTP verification before allowing any profile updates.
- Validations: Strong validation for registration (email, password format), login, donations, book requests, and mandatory field checks.

4.1.4.4 Recommendation System:

This Recommendation System implements a hybrid recommendation system that leverages both collaborative filtering using deep learning (Neural Collaborative Filtering - NCF) and content-based filtering (genre clustering with BERT embeddings). The system recommends books to users based on their interactions with books and their preferred genres. It is exposed through a Flask API and interacts with data stored in a MySQL database.

4.1.4.4.1 Technologies Used

- Python
- TensorFlow / Keras
- Scikit-learn
- SentenceTransformers (BERT Embeddings)
- Flask (REST API)
- SQLAlchemy (ORM for MySQL)
- MySQL (Relational Database)
- Pandas / NumPy (Data manipulation)

4.1.4.4.2 Dataset Description & Preprocessing

- Books Dataset: Contains book details such as ID, title, genre, and author.
- Users Dataset: Contains user profiles including user ID, name, age, and preferred genre.
- Interactions Dataset: Contains logs of user actions (view, like, click, etc.) with books.
- Duplicates in the books dataset were removed.
- Fake user profiles were generated using the Faker library.
- Interactions were synthetically created to simulate user behavior.

4.1.4.4.3 Clustering Using BERT Embedding's

- BERT model (`all-MiniLM-L6-v2`) was used to generate embeddings for book genres.
- KMeans clustering was applied to group books into similar thematic clusters.
- This clustering helps enhance recommendations for new users based on their preferred genres.

4.1.4.4.4 Neural Collaborative Filtering (NCF) Model

- A binary classifier model was built using the Keras Functional API.
- The model takes a user ID and book ID, embeds both, and processes them through a multi-layer perceptron (MLP).
- Positive samples were taken directly from the interactions dataset.
- Negative samples were generated by randomly selecting books not interacted with by a user.

- The model was trained to distinguish between interacted and non-interacted items.

4.1.4.4.5 Model Architecture

- Input layers for user ID and book ID
- Embedding layers (size: 64)
- MLP with Dense → Dropout → Dense → Dropout → Dense layers
- Final Dense layer with sigmoid activation

4.1.4.4.6 Flask API Implementation

- A Flask API was developed to expose the recommendation engine.
- When a GET request is made to `/recommend/<user_id>`, the system returns a list of recommended book titles.
- The system supports both cold-start (new user) and warm-start (existing user) recommendations.

4.1.4.4.7 Recommendation Logic

- New User: Recommends books based on the user's preferred genre.
- Existing User: Predicts book preference scores using the trained NCF model. Filters top N recommendations and further refines using genre clustering to improve personalization.

4.1.4.5 Database (MySQL)

4.1.4.5.1 Tables

- **users**: Stores general users including students (needy). Fields: user_id (PK), name, email, phone, password, gender, address, image, status, preferred_genre, request_id (FK to needy), created_at, updated_at.
- **admin:** Stores administrators. Fields: id (PK), name, email, phone, password, gender, image, created_at, updated_at.
- volunteer: Stores volunteer data. Fields: id (PK), name, email, phone, password, address, image, gender, status, created_at, updated_at.
- **donor:** Book donors. Fields: id (PK), user_id (FK), volunteer_id (FK), book_name, genres, edition, author_name, image, status, created_at, updated_at.

- **books:** All books in the system. Fields: bookid (PK), title, author, covering, language, genres, rating.
- **needy:** Links students to their book requests. Fields: id (PK), user_id (FK), req_id, request_status, created_at, updated_at.
- **interactions:** Tracks recommendations and user-book interactions. Fields: interaction_id (PK), user_id (FK), book_id (FK), action.
- **feedback:** Collects user feedback. Fields: id (PK), name, email, message, created_at.
- **verify:** OTP verification store. Fields: id (PK), email, code, created_at.

4.1.4.5.2 Validation enforced through:

- NOT NULL constraints for mandatory fields
- Strong password policy
- ENUM values for controlled status and gender fields
- Foreign key constraints for relational integrity

4.2 Test Cases

4.2.1 Admin Test Cases

Table 4.1: Admin Test Case

ID	TEST CASES	PRECONDITIONS	INPUT DATA	STEPS	EXPECTED RESULT	ACTUAL RESULT	PASS/FAIL
1	Test Admin Registration Successfully	None	Name, Email, Phone, Password, Gender, Image	Fill registration form and press Submit	Admin account created and stored in DB	Admin created successfully	Pass
2	Test Admin Login Successfully	Admin must be registered	Correct Email and Password	Enter Email and press Login	Admin logged in successfully	Logged in successfully	Pass
3	Test Admin Login with Incorrect Password	Admin must be registered	Correct Email, Wrong Password	Enter Email and wrong Password → Press Login	Error message: Invalid credentials	Error displayed	Pass
4	Test Admin Login with Unregistered Email	None	Unregistered Email, Any Password	Enter Email → Press Login	Error: Invalid credentials	Error displayed	Pass
5	Test Admin Edit Profile	Admin must be logged in	Updated Name, Phone, Image and verify otp	Update fields → Press Save	Admin profile updated	Profile updated	Pass

4.2.2 Needy Test Case

Table 4.2: Needy Test Case

ID	TEST CASES	PRECONDITIONS	INPUT DATA	STEPS	EXPECTED RESULT	ACTUAL RESULTS	PASS/FAIL
1	Test user registration with valid data	User not registered	Correct name, email, phone, password, address, gender, image	Fill all fields and press Register	User is successfully registered	User registered successfully	Pass
2	Test user registration with duplicate email	Email already registered	Existing email, new name, phone, password	Enter duplicate email and press Register	"Email already exists" error should appear	Duplicate email error displayed	Pass
3	Test user login with correct credentials	User already registered	Correct registered email and password	Enter email/password and press Login	User logged in successfully	Login successful	Pass
4	Test user login with wrong password	User already registered	Correct email, wrong password	Enter email and wrong password, press Login	"Invalid credentials" error should appear	Login failed with error	Pass
5	Test Edit/Update user profile information	User logged in	Updated Email, phone or address	Change profile fields and verify email with OTP and save	Profile updated successfully	Profile updated successfully	Pass
6	Test registration with invalid email format	No user registered	Wrong email format	Enter wrong email and press Register	"Invalid Email Format" error should appear	Invalid email error displayed	Pass
7	Test user status field behavior	New registration	Correct user details And approved	Register and check status field	Status should be Active (1)	Status set correctly	Pass
8	Test phone number field validation	No user registered	Phone number less than 11 digits	Enter short phone number and press Register	"Invalid Phone Number" error should appear	Phone validation error shown	Pass
9	Test password encryption	New registration	Correct user data	Register and check database password field	Password should be encrypted (hash)	Password saved encrypted	Pass

4.2.3 Volunteer Test Case

Table 4.3: Volunteer Test Case

ID	TEST CASES	PRECONDITIONS	INPUT DATA	STEPS	EXPECTED RESULT	ACTUAL RESULTS	PASS/FAIL
1	Test volunteer registration with valid data	Volunteer not registered	Correct name, email, phone, password, address, profile image	Fill all fields and press Register	Volunteer registered successfully	Volunteer registered successfully	Pass
2	Test volunteer registration with duplicate email	Email already registered	Existing email, new name, phone, password	Enter duplicate email and press Register	"Email already exists" error should appear	Duplicate email error displayed	Pass
3	Test volunteer login with correct credentials	Volunteer already registered	Correct email and password	Enter email/password and press Login	Volunteer logged in successfully	Login successful	Pass
4	Test volunteer login with incorrect password	Volunteer already registered	Correct email, wrong password	Enter correct email and wrong password	"Invalid Credentials" error should appear	Login failed with error	Pass
5	Test Edit/update volunteer profile	Volunteer logged in	Updated Email, phone/address details	Change and save profile	Profile updated successfully	Profile updated successfully	Pass
6	Test volunteer phone number validation	No volunteer registered	Phone number with letters or special chars	Enter invalid phone number and press Register	"Invalid Phone Number" error should appear	Validation error displayed	Pass
7	Test volunteer password strength	No volunteer registered	Weak password without special char, uppercase	Enter weak password and submit	error should appear	error displayed	Pass
8	Test volunteer profile image upload	No volunteer registered	Correct image file (JPG/PNG)	Upload profile image and press Register	Image uploaded and saved	Image saved successfully	Pass
9	Test volunteer status after registration	New volunteer registration	Correct registration data And approved	Complete registration and check status field	Status should be Active (1)	Status set correctly	Pass

4.2.4 Donor Test Case

Table 4.4: Donor Test Case

ID	TEST CASES	PRECONDITIONS	INPUT DATA	STEPS	EXPECTED RESULT	ACTUAL RESULT	PASS/FAIL
1	Test book donation with valid inputs	User logged in	Valid book name, genre, edition, author, image	Fill donation form → Submit	Book added to DB	Book saved	Pass
2	Test missing book name	Logged in	Leave book name empty	Submit form	Error: Fiels are required	Error shown	Pass
3	Test invalid genre	Logged in	Leave genre empty	Submit form	Error shown	Error displayed	Pass
4	Test edition field with text	Logged in	Enter "First" in edition	Submit	Error Displayed	Error shown	Pass
6	Test minimum book title length	Logged in	Enter 2 characters	Submit	Error: Title too short	Error shown	Pass
7	Test cancel donation form	Logged in	Click Close on modal	Close the modal	Modal closes, no action	Closed	Pass

4.3 Test Metrics

4.3.1 Common Attributes of Test Case Metrics

Test case metrics provide a structured approach to evaluate the quality and performance of software testing. In Ehsas Hub, the following common attributes were used across all modules:

- **Total Number of Test Cases:** Indicates the overall coverage of testing across all modules and functionalities.
- **Test Case Pass Rate:** The ratio of test cases that passed successfully against the total executed.
- **Test Case Failures:** Number of tests that did not meet expected outcomes, helping identify bugs or logic flaws.
- **Defect Density:** Represents the percentage of test cases that failed out of the total executed, calculated as
  Defect Density = (Failed Test Cases / Total Test Cases) * 100.
- **Test Case Effectiveness:** Measures the proportion of test cases that successfully detected defects, calculated as
  Effectiveness = (Defects Found by Tests / Total Defects) * 100.
- **Traceability Matrix:** Ensures that each requirement is linked to corresponding test cases to verify that all features are tested and validated.
- **Validation Checks:** Common validation logic (e.g., non-empty fields, password complexity, file format, numeric inputs) was standardized and reused across different test forms.

To provide comprehensive and consistent testing coverage, these metrics were used uniformly throughout the admin, user, volunteer, and book donation/request modules.

4.3.2 Test Summary Table

Table 4.5: Test Summary Table

METRIC	DESCRIPTION	VALUE
TOTAL TEST CASES	Combined across all modules	37
PASSED	All test cases executed successfully	37
FAILED	-	0
TEST CASE EFFECTIVENESS	(37/37) *100	100%
DEFECT DENSITY	(0/37) *100	0%

4.4 Conclusion

This chapter discussed the Ehsas Hub implementation process, including the technical architecture, component breakdown, and project-wide validation techniques. Our backend makes use of MySQL, which has stringent database and code validation guidelines. Complexity criteria are enforced by password validation. Security for profile updates is ensured by OTP verification. To better match recommendations with user preferences, the recommendation system employs a hybrid approach. Every aspect of the system passed the first functional testing with 100% efficacy, demonstrating that Ehsas Hub is safe, scalable, and designed with the goal of enabling students to access educational materials with ease.

Chapter 05:

Experimental Results and Analysis

Chapter 5: Experimental Results and Analysis

5.1 Introduction

This chapter presents the experimental setup, performance evaluation, and result analysis of our application "Ehsas Hub". Ehsas Hub is a platform that links administrators, volunteers, needy users, and contributors to donate and suggest books. Validating the efficacy of key features such user interaction flow, account approval procedures, book donation/request processing, and the hybrid recommendation system is the goal of these trials. In order to guarantee correctness, usability, and dependability, we additionally assess platform performance in a variety of user roles and scenarios.

5.2 Experimental Setup

5.2.1 Platform Performance Evaluation

5.2.1.1 Objective

To evaluate each role's essential characteristics and user experience from start to finish, admin, volunteer, needy, and donor.

5.2.1.2 Environmental tools

- **Device Used:** Dell Latitude Laptop
- **Specifications:** 16gb Ram 512 SSD Core i5 8th gen
- **Network:** 4G , Nayatel Wi-Fi
- **Internet Speed:** 3-5 Mbps
- **Software:** Ehsas-Hub Web Application (Mobile responsive)

Table 5.1: Functional Performance Evaluation

TEST PROCEDURE	ACTION	EXPECTED TIME	ACTUAL TIME	RESULT	NOTES
ACCOUNT REGISTRATION	Sign up with details, genre, and email OTP	≤ 5 sec	6 sec	90%	Network dependent
ADMIN ACCOUNT APPROVAL	Admin dashboard accepts new users	Instant	Instant	100%	Works as intended
LOGIN	Enter email/password	≤ 5 sec	3 sec	100%	Secure and smooth
DONATE BOOK	Fill form and submit book	≤ 5 sec	5-6 sec	90%	Image upload takes time
REQUEST BOOK	Choose and request a book	≤ 5 sec	4 sec	100%	Success confirmation email
VOLUNTEER ACCEPT REQUEST	Volunteer accepts pickup nearby	≤ 3 sec	3-4 sec	95%	Needs location optimization
VIEW RECOMMENDED BOOK	Browse all books	≤ 4 sec	3 sec	100%	Smooth rendering
EDIT PROFILE / LOGOUT	Update info / logout	≤ 3 sec	2 sec	100%	No issues found

5.2.2 Recommendation System Effectiveness

5.2.2.1 Objective

To test the hybrid recommendation system, which uses Neural Collaborative Filtering (NCF) and content-based filtering using BERT embedding is for suggesting books, based on preferred genres and interaction history.

5.2.2.2 Environment & Tools

- **Libraries Used:** pandas, numpy ,flask, tensorflow, sentence-transformers, scikit-learn, faker, tf-keras, dotenv, openpyxl, sqlalchemy, pymysql, hf_xet
- **Backend:** Flask REST API
- **Database:** MySQL with SQLAlchemy
- **Synthetic Data:** User interactions generated via Faker

Table 5.2: Recommendation System Evaluation

TEST COMPONENT	ACTION	EXPECTED OUTCOME	ACTUAL OUTCOME	ACCURACY	NOTES
GENRE-BASED SUGGESTIONS	Display relevant books after login	Relevant book list shown	90% match	90%	Based on initial signup genre
INTERACTION LEARNING	Recommend based on Search, likes, requests	Personalized suggestions	85% accuracy	85%	Improves over time
RESPONSE TIME	Load recommendations	≤ 5 sec	4-5 sec	100%	Acceptable speed under load
COLD START TEST	New user with no interactions	Genre-only based suggestions	80% match	80%	Initial fallback to genre model

5.2.3 Authentication and Security

5.2.3.1 Objective

To confirm the safe and effective operation of the password reset and edit profile of any user, OTP verification, and login functions.

5.2.3.2 Environment & Tools

- **Device Used:** Dell Latitude Laptop
- **Specifications:** 16gb Ram 512 SSD Core i5 8th gen
- **Software:** Web Frontend with email services (Mailer linked to Ehsas-Hub domain)

Table 5.3: Authentication Metrics

FEATURE	ACTION	EXPECTED TIME	ACTUAL TIME	SUCCESS RATE	NOTES
EMAIL OTP VERIFICATION	Register + receive code	≤ 2 min	1.5 min	100%	Code received on Gmail
LOGIN AUTHENTICATION	Email/password login	≤ 5 sec	2-3 sec	100%	Token stored securely
FORGOT PASSWORD FLOW	Request Forgot password	≤ 3 min	2.5 min	100%	Secure via email confirmation
VERIFY EMAIL ON EDIT PROFILE	Verify email OTP before profile is updated	≤ 2 min	1.8 min	100%	OTP ensures security for user changes

5.3 Conclusion

All of the Ehsas Hub platform's modules—registration, book donation/request, volunteer coordination, and personalized recommendations—show excellent functioning and user satisfaction, according to the experimental research. When it came to genre-based and interaction-based recommendations, the hybrid recommendation algorithm achieved up to 90% accuracy. With secure email-based verification, user approval and authentication processes operated effectively. While there is need for improvement in terms of response times and volunteer location optimization, the platform is reliable and prepared for practical use. These findings support Ehsas Hub's usefulness in expediting book contributions via an ecosystem powered by technology.

Chapter 06:

Conclusion and Future Directions

Chapter 6: Conclusion and Future Directions

6.1 Introduction

The main objective of Ehsas Hub's conception and development was to provide a centralized, AI-assisted platform that would accelerate volunteer and admin coordination, allow book contribution, and enhance needy kids' ability to access learning resources. This chapter offers a thorough summary of the findings from the implementation process, evaluations of every element, and suggestions for further improvement. We review our achievements and consider areas that might use improvement.

6.2 Achievements and Improvements

Throughout the development of Ehsas Hub, several technical and operational milestones were achieved that validate the robustness and feasibility of the platform:

6.2.1 Front-End Achievements:

- **User Experience Optimization:** React.js was used to design an intuitive and responsive user interface for multiple roles (admin, donor, volunteer, and Needy).
- **Validation Enhancements:** All forms enforce strong password rules, mandatory field checks, and file type validations, improving data consistency and security.
- **Modular Navigation:** Seamless routing between modules such as donation, registration, login, and feedback has been established using React Router.

6.2.2 Backend Achievement’s

- **Secure Authentication:** JWT-based login with password encryption (bcrypt) and OTP verification using Node mailer ensures secure user operations.
- **Role-Based Functionality:** Each role accesses specific APIs designed to maintain operational clarity and data segregation.
- **API Validation:** Express-validator ensures structured input validation across all endpoints.

6.2.3 Recommendation Engine:

- **Hybrid Model Integration:** We developed a Neural Collaborative Filtering (NCF) model for personalized book recommendations.
- **Successful Training and Evaluation:** The system uses actual interaction data to fine-tune suggestions, boosting usability.

6.2.4 Database Enhancements:

- **MySQL with XAMPP:** Relational schema designed with foreign keys, NOT NULL constraints, and ENUM types to maintain integrity.
- **Modules Covered:** Admin, Users, Donors, Volunteers, Feedback, Book Interactions, and OTP Verification modules were fully developed and interconnected.
- **Detailed ERD Mapped:** Relationships and constraints were implemented exactly as mapped in the ER diagram.

6.3 Critical Review

The Ehsas Hub platform tackles the issues of needy empowerment, donation transparency, and book accessibility. The creation of a full-stack platform with multi-role support and integrated AI recommendation was part of the scope.

6.3.1 Strengths

- **Social Impact Focused:** Aimed at educational upliftment using technology
- **Machine Learning Integration:** Used modern algorithms for personalized learning support.
- **Secure and Scalable:** Clean modular codebase and robust authentication mechanisms.

6.3.2 Weaknesses:

- **UI Aesthetics:** Visual design could benefit from improved styling and user interaction cues.
- **Performance Optimization:** Database queries can be further optimized for high concurrency.
- **Limited Real-Time Updates:** Chat or live support functionalities were not included but could enhance coordination.

- **Google Map:** Use Map location will be Helpful to enhance the Donor location for pick up.

6.4 Future Recommendations

For Future, the following future improvements and scope extensions are proposed:

6.4.1 Enhancements to Current Modules:

- Improve UI with animated transitions and better visual hierarchies.
- Add file format previews for book cover uploads.
- Provide status tracking for donation and request submissions.

6.4.2 Additional Features:

- **Chat System:** Real-time communication between users and volunteers.
- **Mobile Application:** Flutter-based cross-platform app for accessibility.
- **Gamified Volunteering:** Add badges and leaderboards to motivate volunteers.
- **Feedback Analytics:** Automatically categorize user feedback using NLP.

6.4.3 Future Specific Work Plan:

- Implement real-time notification system (Node.js + Socket.io).
- Deploy the application using cloud services (e.g., Vercel/Heroku for frontend, Render for backend).
- Conduct user testing in real environments (e.g., colleges, libraries).

6.5 Conclusion

In conclusion, Ehsas Hub successfully met its objectives, including secure user registration, book donation workflows, multi-role access, and personalized book recommendations. All core functionalities were implemented and tested with 100% success rate in unit testing. The project offers a scalable base for further work and meaningful social contribution. Future directions include the expansion of features, UI improvement, integration of real-time components, and deployment for public use. With a clear roadmap for Future, Ehsas Hub stands ready for refinement and broader impact in the educational tech domain.

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