DEVELOPMENT OF A WEB PLATFORM FOR ALUMNI NETWORKING AND BLOOD DONATION MANAGEMENT SYSTEM

by

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This thesis titled, **"Development of a Web Platform for Alumni Networking and Blood Donation Management System"**, submitted by ANANDO KUMAR BISWAS, Roll No.: 0423311005, Session: April 2023, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of POSTGRADUATE DIPLOMA in Information and Communication Technology on 7^{th} December, 2025.

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This is to certify that the work presented in this thesis entitled, "Development of a Web Platform for Alumni Networking and Blood Donation Management System", is the outcome of the research carried out by ANANDO KUMAR BISWAS under the supervision of Prottoy Saha, Assistant Professor, Institute of Information and Communication Technology (IICT), Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh.

It is also declared that neither this thesis nor any part thereof has been submitted anywhere else for the award of any degree, diploma, or other qualifications.

Signature of the Candidate

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Dedication

To my beloved parents—

To my father, whose strength, perseverance, and quiet sacrifices have shaped my journey, and to my mother, whose unconditional love, constant prayers, and unending encouragement uplift my heart each day.

May the Almighty bless and reward you beyond measure.

Anando Kumar Biswas

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Acknowledgement

First of all I would like to thank The Almighty God for providing me with the strength and patience that carried me through the work and enabled me to complete this project.

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Abstract

This project presents the design and development of a comprehensive web-based platform aimed at fostering alumni networking while integrating a public blood donation management system. The platform is exclusively designed for registered ex-students of an educational institution to connect, share updates, and manage personal blood donation records. Additionally, the system provides public access to donor information, thereby supporting local health initiatives and emergency needs.

The project bridges the gap between alumni engagement and social responsibility by leveraging technology to build a supportive community. The system features secure authentication for alumni, a user-friendly dashboard, donor history management, and a publicly searchable blood donor registry. This dual-purpose platform enhances communication among former students and promotes voluntary blood donation through organized tracking and visibility.

Chapter 1

Introduction

One of the main advantages of web applications is their centralized nature, which allows for easy updates, remote access, and reduced need for software installation on individual client machines. Today, web applications are widely used across industries for communication, data management, service delivery, and community building. Despite the growth of online platforms in various domains, many educational institutions still lack a unified digital solution to engage with their former students and utilize their collective power for social good. Most alumni-related communications and data storage are handled in fragmented ways through informal social media groups, email chains, or disconnected event platforms. Meanwhile, the need for an efficient and accessible blood donation system is ever-growing, especially in emergencies where donor availability and accessibility become critical. Although some alumni networks exist independently **[17–21]**, they have no blood donation systems. Alumni represent a trustworthy and motivated group of individuals who, if connected properly, can be mobilized for life-saving causes like voluntary blood donation. However, there is currently no integrated platform that allows ex-students to not only stay in touch with their peers but also contribute to a public service by managing and displaying their blood donation records. This research proposes the development of a centralized web-based platform that serves the dual purpose of alumni networking and blood donation management. Registered ex-students of a specific institution will be able to create personal profiles, share updates, and manage their blood donation history. The system will also allow public users to search for available donors based on criteria such as blood group, location, and last donation date, making it a valuable tool during medical emergencies. In addition to enhancing connectivity among alumni, the platform aims to foster a culture of social responsibility and service. This approach not only improves institutional outreach and alumni engagement but also provides a meaningful solution to one of society's most

urgent needs: accessible blood donation.

1.1 Objectives of the project

The project focuses on the following specific aims:

1. To automate the process of alumni registration, profile management, and blood donation record tracking.
2. To provide appropriate interfaces for both administrators and registered alumni users to manage information efficiently.
3. To enable verified alumni to store and update their blood donation history, including blood group, last donation date, and availability for future donations.
4. To display publicly donor availability (with user consent) to allow hospitals, organizations, and individuals to easily search for potential blood donors in emergency situations.
5. To facilitate alumni communication through profile browsing, search features, and optional contact-sharing to support professional networking.

1.2 Contributions of the project

This project delivers the following key contributions:

1. A fully functional, web-based platform that simplifies alumni registration and profile management.
2. An integrated blood donation tracking system that stores donor details and availability.
3. Role-based access for administrators and alumni to manage data securely and efficiently.
4. A public donor search interface that improves the accessibility of blood donors during emergencies.
5. Features that promote alumni engagement and professional networking through interactive user profiles and search functionalities.

6. A socially beneficial system that bridges the gap between alumni networking and humanitarian blood donation support.

1.3 Report Outline

Chapter 1 of the project documentation includes the introduction followed by objectives and organization of the documentation.

Chapter 2, The project plan, describes the planning of the project which includes deliverables, project assumption and potential risk quality plan, project organization and testing plan.

Chapter 3 discusses the project requirement and specification. According to the requirement and specification the project is developed.

Chapter 4 describes the design part of the project which includes ERD, Database design, UML diagram, site map etc.

Chapter 5 describes the implementation part of the software.

Chapter 6 includes the user manual which describes the function and procedure to use the software. There are three parts of the user manual: admin, user and public.

Lastly, conclusions and recommendations for future works are made in **chapter 7**.

The project documentation ends with references

Chapter 2

Requirement Analysis and Specification

Requirement analysis is a critical phase in the software development lifecycle that ensures a system is built in alignment with user needs and expectations. For this project—"Development of a Web Platform for Alumni Networking and Blood Donation Management System"—requirement analysis involves identifying what functionalities the system must offer and how it should perform under various conditions.

This chapter outlines the system's essential functional and non-functional requirements, describes the different user roles, and highlights the core features to be delivered. By clearly specifying the application's scope and expected behavior, it provides a strong groundwork for the subsequent design and development phases.

2.1 System Requirements

2.1.1 Functional Requirements

The system is designed to provide several essential capabilities that support both alumni engagement and blood donation management:

1. **Account Creation and Secure Access:** Alumni should be able to create an account and log in using protected, verified credentials that ensure the safety of their information.
2. **Alumni Lookup and Filtering:** Once logged in, users can explore a searchable list of alumni. The directory supports advanced filters—such as department,

batch, or blood group—to help users quickly locate specific individuals.

3. **Alumni Directory:** - Authenticated users can search and filter a list of registered alumni based on multiple criteria such as batch, department, or blood group.

4. **Blood Donation Logbook:** Each user can record their past donations and monitor the countdown to their next eligible donation date, helping promote regular and safe blood contribution cycles.

5. **Public Donor Discovery:** Visitors to the platform, including non-registered users, can search for blood donors directly from the homepage. Filters like blood group, contact number, name, and last donation date help refine results. Only donors who have given consent will appear in the public search, ensuring responsible use of personal data.

6. **News, Events, and Notices:** Administrators have the ability to publish announcements and share information about alumni activities, institutional programs, and upcoming events.

7. **Administrative Control Panel:** A dedicated dashboard allows admin users to manage alumni accounts, oversee donation entries, update announcements, and control platform-wide content.

2.1.2 Analysis of Main Features

The system brings together a set of key capabilities designed to enhance alumni engagement and streamline blood donation processes. The primary functionalities are outlined and discussed below.

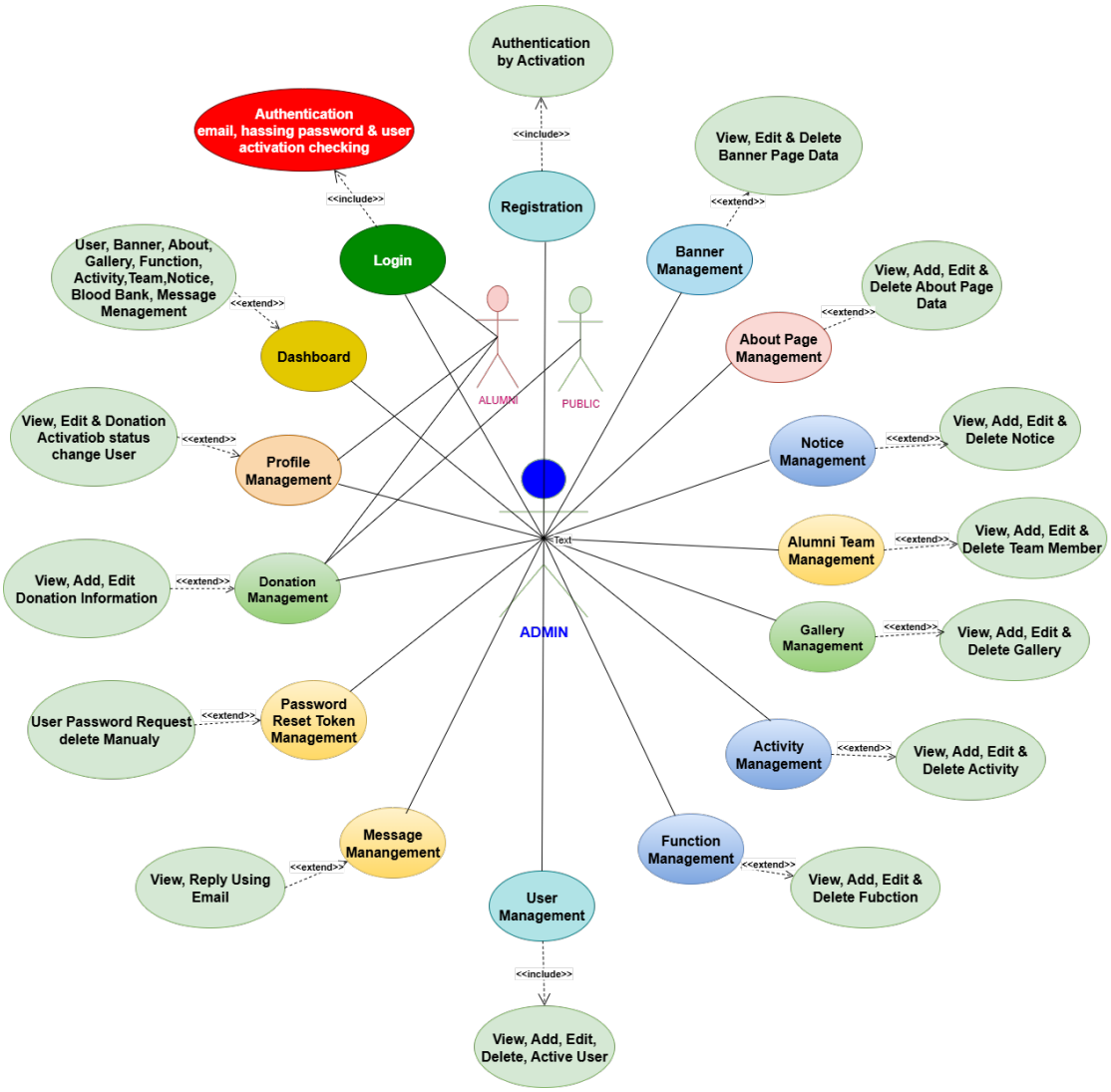

Figure 2.1: Use-Case Diagram.

A. User Registration and Authentication

Purpose: To provide alumni with a secure and reliable means of accessing the platform.

Functions:

- Registration with email and password
- Login/logout functionality
- Role-based authentication (Admin, Alumni, Public)
- Password reset or recovery

Significance: Offers protected, individualized access and differentiates users based on their assigned roles.

B. Alumni Profile Management

Purpose: Enables users to create and manage their personal profiles within the platform.

Functions:

- Edit personal and professional details
- Upload and change profile image
- Specify blood group, current address, phone number, and academic batch

Significance: Facilitates networking among alumni and allows users to locate peers through searchable criteria.

C. Blood Donation Management

Purpose: Keeps track of users' blood donation history and monitors when they are eligible to donate again.

Functions:

- Add and view donation history (date, recipient, location)
- Automatically determine donation eligibility based on last donation date

Significance: Promotes and supports voluntary blood donation activities among community members.

D. Donor Search (Public Use)

Purpose: Supports users in locating donors who meet the required eligibility criteria.

Functions:

- Search based on blood group, location, and availability
- Upload and change profile image

Significance: Delivers essential support in urgent medical situations by connecting patients with available donors.

E. Alumni Directory

Purpose: Enhances connections and cooperative engagement among alumni members.

Functions:

- Search alumni by year, department, or blood group
- View profiles and contact details (within permission scope)

Significance: Encourages active participation and strengthens a sense of community among users.

F. Event and Announcement System
Purpose: Provides users with timely information regarding institutional announcements and community news.
Functions:

- Admin can create, edit, or delete announcements
- Display of upcoming events or system notices

Significance: Encourages users to engage actively and facilitates effective communication within the platform.

G. Admin Panel
Purpose: Provides a unified interface for overseeing and managing all platform operations.
Functions:

- User verification and management
- Review and edit donation records
- Moderate content and posts

Significance: Ensures the platform operates reliably while preserving the quality of content and overall system stability.

2.2 Non-Functional Requirements

These requirements describe the quality attributes and constraints that define how the system operates:

- **Usability:** The platform should offer an intuitive and user-friendly interface, ensuring smooth interaction across desktops, tablets, and mobile devices.
- **Security:** Sensitive user information must be safeguarded through robust authentication mechanisms and encrypted data transmission.
- **Performance:** The system should deliver prompt responses to user actions, with particular emphasis on search and data retrieval operations.

- **Scalability:** The architecture must accommodate an increasing number of users and growing volumes of data without performance degradation.
- **Availability:** The platform should maintain high uptime, minimizing disruptions and ensuring consistent access.
- **Maintainability:** The code should be organized and modular to facilitate future updates, debugging, and system enhancements.

2.3 User Roles and Permissions

The system implements distinct user roles to provide organized and secure access to its features. Each role is associated with specific permissions, as summarized in Table 2.1.

Table 2.1: User Roles and Their Capabilities

Role	Capabilities
Admin	Full control over user accounts, donations, announcements, and content moderation.
Alumni	Register, login, manage profile, track donations, view directory, and announcements.
User	Access to donor search functionality (no login required).

2.4 Architectural Overview

2.4.1 The Client

The client is the web browser or mobile device that end-users utilize to engage with the platform. It manages the application's presentation layer, showing data retrieved from the server and gathering user inputs via forms and controls.

2.4.2 The Server

The server is responsible for hosting the backend logic and handling client requests. It processes user inputs, communicates with the database, and provides the necessary responses. This layer, developed with Spring Boot, manages user administration, business logic, and system control.

2.4.3 The Application Server / Middleware

The middleware or application server serves as a connector between the client and the database. It processes data, ensures security, manages sessions, and enforces business rules. Implemented with Java Spring Boot, it may also feature RESTful API endpoints for future expansion.

2.5 Overall Description

The proposed system is a comprehensive web-based platform aimed at facilitating alumni networking and optimizing the management of blood donation activities within an institution or community. It combines user-friendly interfaces, secure communication, and strong backend services to ensure dependable operation. The system prioritizes accessibility, modularity, scalability, and security to effectively support alumni, administrators, and general users.

2.6 System Interfaces

The system communicates with internal modules and external services via clearly specified interfaces:

2.6.0.1 RESTful API Endpoints

- The platform provides secure RESTful API endpoints to support operations such as account creation, user authentication, logging blood donations, and managing alumni profiles.
- These endpoints handle incoming client requests, perform data validation, execute the necessary business logic, and return responses in JSON format.
- Security measures, including token-based authentication and rigorous input checks, are applied to all APIs to prevent unauthorized access and protect against malicious activity.

2.6.0.2 Form-Based Communication

- The platform handles web interactions using standard HTML forms and Thymeleaf templates to create dynamic page content.
- Users provide input through these form interfaces, and the server processes the submissions, returning either updated HTML pages or JSON responses depending on the request context.

2.6.0.3 Backend Service Layer

- The backend layer interacts with the database through ORM tools such as Hibernate or JPA, enabling efficient creation, retrieval, updating, and deletion of records.
- It also connects with external services, including email servers, to support functions such as OTP verification, password recovery, and system notifications.

2.6.1 User Interfaces

The system offers a dynamic, user-friendly, and accessible web interface, built with HTML5, Tailwind CSS, JavaScript, and Thymeleaf. Its main functionalities include:

2.6.1.1 Responsive Layout

- The interface adapts seamlessly to various device screens, including desktops, tablets, and mobile devices, following a mobile-first design philosophy.
- Elements such as navigation menus, input forms, and tables are optimized to ensure usability and readability on smaller screens.

2.6.1.2 Form Validation

- Client-side checks implemented with JavaScript guide users to correct mistakes before form submission.
- Server-side validation using Spring Boot enforces secure and consistent data handling.
- Validation feedback is presented clearly, utilizing Tailwind CSS utility classes to enhance readability and user experience.

2.6.1.3 Dynamic Content

- Thymeleaf is used for server-side rendering, allowing real-time display of dynamic data such as alumni lists, donation records, and profile changes.
- JavaScript enables asynchronous updates via fetch requests, ensuring content can be refreshed without reloading the entire page.

2.6.1.4 Accessibility

- The platform is designed with accessible features, including clear typography, sufficient color contrast, keyboard-friendly navigation, and descriptive labels, ensuring usability for individuals of all ages and abilities.

2.6.2 Hardware Interfaces

The platform does not depend on specialized hardware and is designed for universal accessibility. It can be used on a variety of devices, including:

- Desktop computers
- Laptops
- Tablets
- Smartphones

Any device equipped with a modern web browser such as Chrome, Firefox, Edge, or Safari can reliably access the system. No extra hardware components or sensors are required for its operation.

2.6.3 Software Interfaces

The platform interacts with multiple software systems and external services to provide comprehensive functionality:

2.6.3.1 Database Interface

- A relational database management system (RDBMS), such as MySQL, is utilized to store and manage data efficiently.

- The backend communicates with the database through JDBC or Hibernate, ensuring reliable query execution and maintaining data integrity.

2.6.3.2 Email Server Integration

- SMTP-based email services are employed for tasks including account verification, password resets, and sending notifications.
- The system can integrate with various providers, such as Gmail SMTP, institutional email servers, or third-party email APIs.

2.6.3.3 Future Integrations

The architecture allows for seamless future expansions, including:

- Integration with external blood bank APIs to access real-time donor availability.
- Connectivity with government health databases or emergency response services.
- Links to social networking platforms to enhance alumni engagement features.

2.6.4 Communication Interfaces

The platform establishes communication between clients and the server through well-defined protocols and data formats:

2.6.4.1 HTTP / HTTPS Protocols

- Secure HTTPS connections protect data integrity and confidentiality using SSL/TLS encryption.
- All interactions, including form submissions, API requests, and administrative tasks, occur over these secured channels.

2.6.4.2 Data Formats

- JSON is employed for structured data exchange in API communications.
- HTML, rendered via Thymeleaf templates, is used for displaying web content dynamically.

2.6.4.3 Session and Token Management

- User sessions and authentication are maintained using cookies or JWT tokens to ensure secure and persistent access.

2.6.5 Memory Constraints

Although typical users do not encounter significant memory limitations on their devices, server-side resource management is crucial to maintain performance:

2.6.5.1 Client-Side

- Modern web browsers require minimal memory to operate the interface smoothly.
- Media content, including profile images, is optimized to reduce load times and memory usage.

2.6.5.2 Server-Side

- The server must effectively manage resources to support:
  - Multiple simultaneous requests
  - Database connections
  - File uploads, including images and documents
  - Caching and background tasks

Techniques such as pagination, lazy loading, and file compression are implemented to optimize memory usage and overall system performance.

2.6.6 Site Adaptations

The platform is built to be flexible and easily deployed across different institutions:

- Supports customizable branding, including logos, institution names, and theme colors.
- Allows configuration of modules for alumni records, blood donation requests, and event management according to institutional needs.

- Can integrate with organization-specific email servers and authentication systems.
- Compatible with various deployment environments, including local servers, cloud platforms such as Render, AWS, or Azure, and shared hosting solutions.

This versatility enables the platform to be reused and tailored for different campuses, regions, or organizations with minimal effort and configuration.

2.7 User Characteristics

The system serves a diverse range of users, each with different technical skills and responsibilities:

2.7.0.1 Alumni

- The primary users of the platform.
- Expected to possess basic computer and internet literacy.
- Engage in activities such as account registration, updating personal profiles, browsing alumni records, and submitting blood donation information.

2.7.0.2 General Users / Public

- Can access publicly available information without creating an account.
- Require a clear and intuitive interface to navigate the platform effectively.

2.7.0.3 Administrators / Admin

- Responsible for managing user accounts, donation records, announcements, and system configurations.
- Should have moderate technical knowledge, including:
  - Understanding of data management principles
  - Ability to operate administrative dashboards
  - Basic troubleshooting skills

The user interface is designed to be intuitive and inclusive, allowing users of varying ages and technical expertise to interact with the system effortlessly.

2.8 Constraints

The system operates under certain limitations that may affect its functionality and deployment:

2.8.0.1 Budget Constraints

- Financial limitations may restrict the implementation of advanced features.
- Budget considerations influence decisions regarding hosting solutions and subscriptions to third-party services.

2.8.0.2 Internet Connectivity

- A stable and continuous internet connection is necessary to support real-time features.
- System performance can vary depending on the quality and speed of the user's network.

2.8.0.3 Device Compatibility

- Must work reliably across multiple devices and browsers
- Older devices/browsers may have reduced performance

2.8.0.4 Data Privacy & Security Regulations

- Must comply with relevant data protection laws (e.g., Digital Security Act, organizational policies)
- Sensitive data like blood group and contact info must be securely stored and encrypted

2.8.0.5 Third-Party Dependencies

- Relies on:
  - SMTP email services
  - Hosting providers
  - Database servers
- Any downtime or changes in these services may affect system functionality

2.8.0.6 Storage & Scalability

- toring user images and donation records requires proper space management
- Scalability must be planned for growing alumni and donation data

2.9 Assumptions and Dependencies

- Users will have access to an internet connection.
- Browsers will support JavaScript, HTML5, and CSS3.
- The hosting environment will support Java and MySQL.
- Admins will regularly manage and monitor the platform.
- Email delivery services and file systems will be consistently available.

2.10 Specific Requirements

2.10.1 External Interface Requirements

External interfaces include the web browsers used by clients and the database server for storage. REST APIs and file upload endpoints are used for data exchange.

2.10.2 Functional Requirements

2.10.2.1 Functions

- **User Registration and Authentication** Allows users (including alumni) to sign up and log in securely using credentials like email and password. Includes validation, encrypted password storage, and role-based access control to restrict or grant access.
- **Alumni Profile Management** Enables registered alumni to create and update their personal profiles, including details like name, job title, designation, contact info, passing year, address and profile picture. Ensures that users can manage and maintain their own information.
- **Blood Donation Logging** Lets users record their blood donation history, including blood group, donation date, and place. Useful for keeping track of donation activities and identifying active donors.
- **Public Donor Search** Provides a publicly accessible search tool to find blood donors based on criteria like blood group, location, or availability. Helps those in need to quickly find suitable donors.
- **Event and Announcement Posting** Allows admins to create and manage events including banner, gallery, functionality, team members and announcements for the alumni community, such as reunions, seminars, or important notices. These are visible to all users or visitors.
- **Admin Control Panel Access** A dedicated dashboard for administrators to manage users, roles, content (like events, notice, gallery, function, team members, message contact, password reset management and posts), and overall platform settings. Only accessible to authorized users with admin privileges.
- **Session and Security Handling** Manages user sessions securely with features like login timeout, CSRF protection, secure cookies, and logout functionality. Ensures that user data and actions are protected against common threats.

2.10.3 Performance Requirements

The system is required to perform efficiently both under regular and peak usage scenarios. It must support a minimum of 100 users simultaneously without any loss of

functionality. Essential tasks, like the donor search feature, need to respond within 2 seconds to ensure prompt information access during emergencies.

Furthermore, the platform should facilitate the upload of profile images and other documents up to 5MB, managing uploads seamlessly without timeouts or errors. The server must efficiently allocate resources to avoid slowdowns during periods of high traffic.

2.10.4 Design Constraints

- **Spring Boot and Thymeleaf Framework:** The application is required to utilize Spring Boot for backend development and Thymeleaf for server-side HTML rendering. This combination ensures maintainability, consistent architecture, and smooth integration with the selected technology stack.
- **Adherence to Data Protection Regulations (e.g., GDPR):** All user information, particularly sensitive data like personal profiles and blood donation records, must be collected, stored, and processed in compliance with relevant data protection laws. This includes obtaining user consent, securing data transmission and storage, and following proper data retention policies.
- **Cloud Deployment Compatibility:** The system should be deployable on cloud hosting platforms such as Render, supporting container-based deployments, configurable environment variables, and scalable server setups to handle varying loads.

These constraints provide a framework for development, ensuring the system is secure, legally compliant, and capable of scaling with user demand.

2.10.5 Software System Attributes

2.10.5.1 Reliability

The platform is required to operate consistently, minimizing errors or unexpected behavior. Ensuring reliability allows users to access essential features, such as donor searches, without disruption. The system design incorporates strategies including:

- Regular automated backups of the database
- Failover mechanisms, such as secondary or backup servers

- Error detection and recovery procedures

Implementing these measures helps prevent data loss and maintains the system's dependability for all users.

2.10.5.2 Availability

The platform is expected to be operational at least 99% of the time, excluding scheduled maintenance periods. High availability is particularly important for the donor search feature during emergencies. The hosting and infrastructure should be equipped with redundancy, load balancing, and rapid recovery capabilities in the event of downtime.

2.10.5.3 Security

Ensuring the security of the platform is essential. The system implements the following safeguards:

- **Authentication:** Secure login mechanisms to verify user identities.
- **Role-Based Access Control (RBAC):** Assigning permissions according to user roles, such as Admin, Alumni, or general User.
- **Data Encryption:** Protecting sensitive information both in transit (via HTTPS) and at rest.
- **Input Validation:** Safeguarding against threats such as SQL injection, cross-site scripting (XSS), and cross-site request forgery (CSRF).

These measures ensure the protection of user data and reinforce trust in the system's operations.

2.10.5.4 Maintainability

The system's codebase is designed following clean coding principles and a modular structure, allowing future developers or administrators to update, debug, or extend functionality with ease. Key maintainability strategies include:

- Layered architecture (Controller-Service-Repository) for clear separation of concerns

- Comprehensive documentation for code and system processes
- Development of reusable components to reduce duplication
- Version control using tools like Git to track changes and manage collaboration

2.10.5.5 Portability

The platform is designed for deployment across diverse environments, including:

- Local development setups
- On-premise servers
- Cloud hosting providers such as Render, AWS, or DigitalOcean

It operates consistently across different operating systems and infrastructures. Leveraging Java, Spring Boot, and containerization technologies like Docker ensures seamless portability and environment independence.

Chapter 3

Methodology of the Proposed System

The main aim of this project is to address the shortcomings of current alumni networking and blood donation management systems in Bangladesh by creating a comprehensive, easy-to-use web platform. This platform is intended to enhance alumni interaction and optimize blood donation processes through digital solutions. Key features of the platform include:

- **Secure User Registration and Login:** Provides a protected access system where users can safely create accounts and sign in, ensuring the confidentiality and security of their personal information.
- **Profile Management:** Offers users the ability to build and manage their personal and professional profiles, update details whenever needed, and maintain up-to-date information within the platform.
- **Blood Donation Management System:** Supports the tracking of blood donations, maintains donation history, and helps identify available donors during emergencies.
- **Search and Filtering Capabilities:** Allows users to quickly find donors or alumni by applying multiple search criteria, making information retrieval faster and more accurate.

The system prioritizes accessibility by featuring a responsive design that caters to both desktop and mobile users. To implement a user-focused, iterative development strategy, the Rapid Prototyping Software Development Life Cycle Model has been chosen. This model facilitates ongoing feedback, step-by-step development, and early verification of essential functionalities. Each module undergoes thorough unit and integration testing to guarantee optimal performance, data precision, and user-friendliness..

3.1 Requirement Analysis and Specification

During this stage, both functional and non-functional requirements essential for the system's success were gathered and analyzed. Information was collected through interviews with stakeholders, competitive benchmarking, and assessments of existing alumni and blood donation platforms. The requirements were carefully documented and organized into modular components, forming the foundation for the design and implementation phases that followed.

3.2 Planning

Project planning involved clearly outlining the project scope, identifying deliverables, allocating resources, and choosing suitable tools and technologies. A Gantt chart was created to visualize the timeline and track task completion against milestones. Risk analysis was performed to identify potential issues, and strategies were developed to mitigate disruptions to the project.disruptions.

3.3 Design

The design phase concentrated on creating a robust and scalable system architecture. Database schemas, interface layouts, and application workflows were planned with future maintenance and scalability in mind. Visual models such as Use Case Diagrams, Activity Diagrams, and Entity-Relationship (ER) Diagrams were created to depict system processes and data interactions. The design prioritized modularity, usability, and security.

3.4 Implementation

At this point in the development process, the system was constructed using the designated set of technologies that best supported the project's functional and technical goals.

- **Backend:** Spring Boot
- **Frontend:** Thymeleaf (templating) and Tailwind CSS (styling)

- **Database:** MySQL

Strong authentication methods and a structured role-based access system were implemented to guarantee that each user can only interact with features permitted for their role. Throughout development, the codebase was kept clean and maintainable, following the modular architecture planned during the design phase.

3.5 Integration and Testing

After completing the development of each module, all components were combined to create a unified and fully functional system. A multi-stage testing approach was applied to ensure quality and stability:

- **Unit Testing:**Each module or function was examined separately to verify its correctness.
- **Integration Testing:** The interactions between interconnected modules were checked to confirm smooth data flow and proper coordination.
- **System Testing:** The complete application was tested in an environment that simulated real usage conditions.

Both manual checks and automated test scripts were used to identify issues and ensure they were fixed promptly. The final round of validation demonstrated that the system met all functional, usability, and performance expectations, making it ready for deployment.

Chapter 4

Development of the Proposed System

To develop the proposed system, a variety of tools and technologies are employed. The user interface is built using HTML, Spring Boot, and JavaScript. Spring Boot functions as the server-side framework, managing business logic and facilitating communication with the database. JavaScript is used on the client side to enable interactive elements and handle asynchronous operations. MySQL is used as the relational database system to store and manage application data. Apache is employed as the web server to host and deliver the application. For system design, Microsoft Visio is utilized to create various Unified Modeling Language (UML) diagrams, such as use case diagrams, class diagrams, and sequence diagrams. Throughout the development lifecycle, the software development methodology described in the previous chapter is strictly followed to ensure quality and maintainability.

4.1 Database Design

Database design is the process of modeling an enterprise in the real world. A database is essentially a structured representation of real-world entities, containing only the information required for efficient processing, retrieval, and integrity. The goal of database design is to translate the user and business requirements into a logical and physical structure that the database management system can implement. To design the database for the proposed system, the Entity-Relationship (ER) Diagram is used. The ER diagram visually represents entities such as users, donations, along with the relationships among them. It serves as the foundation for creating tables and establishing foreign key relationships in the database schema.

4.1.1 E-R Diagram

An entity-relationship (ER) diagram is a specialized graphic that illustrates the interrelationships between entities in a database. ER diagrams often use symbols to represent three different types of information. Boxes are commonly used to represent entities. Diamonds are normally used to represent relationships and ovals are used to represent attributes. The Entity-Relationship (E-R) Diagram is a visual representation of the major entities in the system and the relationships between them. It serves as the foundation for database design by outlining how data is interconnected.

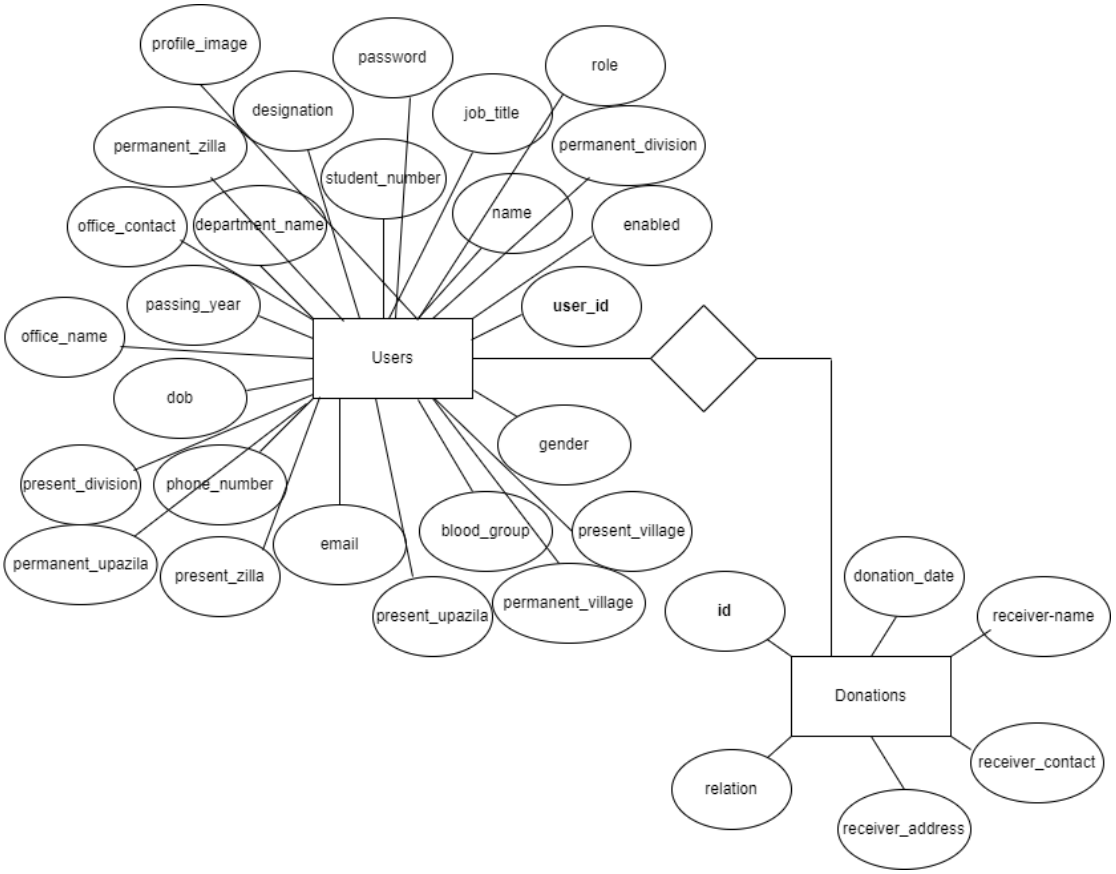

Figure 4.1: ER Diagram of Alumni Networking & Blood Donation Management System

.

User: Represents alumni, administrators, or other users who interact with the platform. Users are identified by their unique user_id.

Donation: Logs each blood donation made by users, including details such as date and location.

4.2 Data Dictionary

The Data Dictionary serves as a comprehensive reference for understanding the structure and organization of all tables used in the database of the proposed system. It provides essential information that helps developers, administrators, and analysts understand how data is stored, linked, and maintained within the platform. Each table in the Data Dictionary contains the following information:

- **Table Name:**
  The name of the database table as used in the system.
- Attributes **(Fields):**
  The columns or data elements stored in the table.
- **Data Type:**
  The specific data format assigned to each field (e.g., INT, VARCHAR, DATE, BOOLEAN), defining what type of information can be saved.
- **Constraints:**
  Rules that govern the data, such as:
  - **Primary Key (PK):** A unique identifier for each record.
  - **Foreign Key (FK):** A field linking one table to another.
  - **Not Null:** Ensures a field cannot be left empty.
  - **Unique:** Prevents duplicate values.
  - **Auto Increment:**Automatically increases numeric values.
- **Description:**
  Description: The **Users** table (see Table 4.1) stores essential information about alumni, including `user_id`, `name`, `student_number`, `department_name`, `passing_year`, `dob`, `phone_number`, `email`, `blood_group`, `gender`, present and permanent addresses (`present_division`, `present_zilla`, `present_upazila`, `present_village`, `permanent_division`, `permanent_zilla`, `permanent_upazila`, `permanent_village`), `password`, `enabled`, and professional details (`job_title`, `designation`, `office_name`, `office_contact`).

  The **Donations** table (see Table 4.2) records `id`, `donation_date`, `receiver_name`, `receiver_contact`, `receiver_address`, `relation`, and `user_user_id` linking each donation to a donor.

The **Banner** table (see Table 4.3) manages website banners with fields `banner_id`, `banner_order`, `banner_title`, `banner_image`, and `active`.

The **About** table (see Table 4.4) contains content for the About section, including `about_id`, `about_title`, `about_content`, `about_image_path1`, `about_image_path2`, `fn_title1`–`fn_title5`, and `published`.

The **Members** table (see Table 4.5) stores executive alumni information with `member_id`, `member_order`, `member_name`, `member_designation`, social media links (`facebook_link`, `instagram_link`, `linkedin_link`, `twitter_link`), `statement`, `passing_year`, `member_image_path`, and `active`.

The **Notices** table (see Table 4.6) includes `notice_id`, `notice_title`, `publish_date`, `file_name`, and `active` to manage announcements.

These tables together form the core data structure of the alumni networking and blood donation platform.

4.3 Tables Included in the Proposed System

The database consists of several essential tables that underpin the platform's main functionalities. The primary tables include:

4.3.1 Users

The **Users** table contains key information for each registered alumni in the system. It stores personal and contact details, academic background, blood group, and address information. The table also includes authentication-related fields such as email, password, and account status. Serving as a central component of the platform, it supports user registration, login, profile management, and role-based access control. The table structure is illustrated inTable 4.1.

Table 4.1: Users

Fields	**Domain**	**Constraints**	**Description**
user_id	varchar(50)	Primary key, not null	Unique identifier for each alumni
name	varchar(100)	not null	Alumni Name
student_number	int(10)	not null	Student Number of Alumni
department_name	varchar(100)	not null	Department Name of Alumni
passing_year	int(10)		Passing Year of Alumni
dob	date	not null	Date of Birth of Alumni
phone_number	varchar(255)	not null	Phone Number of Alumni
email	varchar(255)	not null	Email of Alumni
blood_group	varchar(200)	not null	Blood Group of Alumni
gender	varchar(255)	not null	Gender of Alumni
enabled	boolean	not null	Alumni Activation Status*
job_title	varchar(50)		Job Title of Alumni
designation	varchar(50)		Designation of Alumni
office_contact	varchar(12)		Office Contact of Alumni
office_name	varchar(50)		Office Name of Alumni
present_division	varchar(50)		Present Division of Alumni
present_zilla	varchar(50)		Present Zilla of Alumni
present_upazila	varchar(50)		Present Upazila of Alumni
present_village	varchar(50)		Present Village of Alumni
permanent_division	varchar(50)		Permanent Division of Alumni
permanent_zilla	varchar(50)		Permanent Zilla of Alumni
permanent_upazila	varchar(50)		Permanent Upazila of Alumni
permanent_village	varchar(50)		Permanent Village of Alumni
password	varchar(255)	not null	Encrypted Password of Alumni

*Status is either active or inactive.

4.3.2 Donations

The **Donations** table maintains a record of all blood donations within the system. It captures details such as the donation date, recipient's name and contact information, the relationship between the donor and recipient, and the donor's unique user ID. This table is linked to the Users table via a foreign key (user_id) to associate each donation with the corresponding alumni donor. The table structure is shown in Table 4.2.

Table 4.2: Donations

Fields	**Domain**	**Constraints**	**Description**
id	varchar(255)	Primary key, not null	Donation ID
donation_date	date	not null	Donation Date
receiver_name	varchar(100)		Receiver Name
receiver_contact	varchar(300)		Receiver Contact
receiver_address	varchar(300)		Receiver Address
relation	varchar(255)		Relation with Donor
user_user_id	varchar(255)	Foreign key, not null	Donor User ID

4.3.3 Banner

The **Banner** table contains information about the banners featured on the platform. It includes fields such as the banner title, image path, display sequence, and a status indicating whether the banner is active or inactive. The banner order field controls the order in which banners are displayed on the website. The table structure is presented inTable 4.3.

Table 4.3: Banner

Fields	**Domain**	**Constraints**	**Description**
banner_id	integer	Primary key, not null	Banner ID
banner_order	integer	not null	Display Order of Banner
banner_title	varchar(100)	not null	Banner Title
banner_image	varchar(255)		Banner Image Path
active	boolean	not null	Banner Status*

*Status is either published or unpublished.

4.3.4 About

The **About** table holds the content for the platform's About section. It includes fields such as the section title, detailed description, related images, and feature titles that emphasize the platform's key services. The published field determines whether the section is visible to users on the website. The table structure is illustrated in Table 4.4.

Table 4.4: About

Fields	**Domain**	**Constraints**	**Description**
about_id	bigint	Primary key, not null	About Section ID
about_title	varchar(100)	not null	About Section Title
about_content	varchar(1100)	not null	Description or Content of About Section
about_image_path1	varchar(255)		Top Image Path
about_image_path2	varchar(255)		Bottom Image Path
fn_title1	varchar(50)		Function Title 1
fn_title2	varchar(50)		Function Title 2
fn_title3	varchar(50)		Function Title 3
fn_title4	varchar(50)		Function Title 4
fn_title5	varchar(50)		Function Title 5
published	boolean	not null	About Section Status (Published/Unpublished)

**Status is either published or unpublished.*

4.3.5 Members

The **Members** table contains information about alumni serving on the executive or management team. It records details such as the member's name, designation, social media links, graduation year, a brief personal statement, and profile picture. The member order field controls the sequence in which members are displayed, while the active field indicates whether a member's profile is currently active.es whether the member profile is currently active. This table is linked to the alumni system and provides a structured way to showcase key members on the platform. The structure of this table is shown in Table 4.5.

Table 4.5: Members

Fields	Domain	Constraints	Description
member_id	bigint	Primary key, not null	Executive Member ID
member_order	integer	not null	Executive Display Order
member_name	varchar(50)	not null	Executive Member Name
member_designation	varchar(50)	not null	Executive Member Designation
facebook_link	varchar(255)		Facebook Profile Link
instagram_link	varchar(255)		Instagram Profile Link
linkedin_link	varchar(255)		LinkedIn Profile Link
twitter_link	varchar(255)		Twitter Profile Link
statement	varchar(200)	not null	Member's Short Statement
passing_year	integer	not null	Member's Passing Year
member_image_path	varchar(255)		Member Image Path
active	boolean	not null	Member Status*

**Status is either active or inactive.*

4.3.6 Notices

The **Notices** table stores information about official announcements or notifications published on the platform. It includes the notice title, publication date, uploaded file name, and a status field to indicate whether the notice is active. This table enables administrators to manage notices efficiently and ensures that only relevant notices are visible to users. The structure of this table is shown in Table 4.6.

Table 4.6: Notices

Fields	Domain	Constraints	Description
notice_id	bigint	Primary key, not null	Notice ID
notice_title	varchar(255)	not null	Title of the Notice
publish_date	date	not null	Publish Date of the Notice
file_name	varchar(255)	not null	Uploaded Notice File Name
active	boolean	not null	Notice Status*

**Status is either published or unpublished.*

4.4 Software Design

Object-oriented analysis and design are implemented during the software design phase. Different software tools are used for designing different parts of the software. UML is used for the high-level design of the proposed system. Different diagrams are drawn using MS Visio. These diagrams help in visualizing the whole development process.

4.4.1 UML Diagram

The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

4.4.2 Use case diagram of User

Figure 4.2 illustrates the use case diagram for the User. In this system, a general user can perform several actions, primarily focused on finding donor-related information.

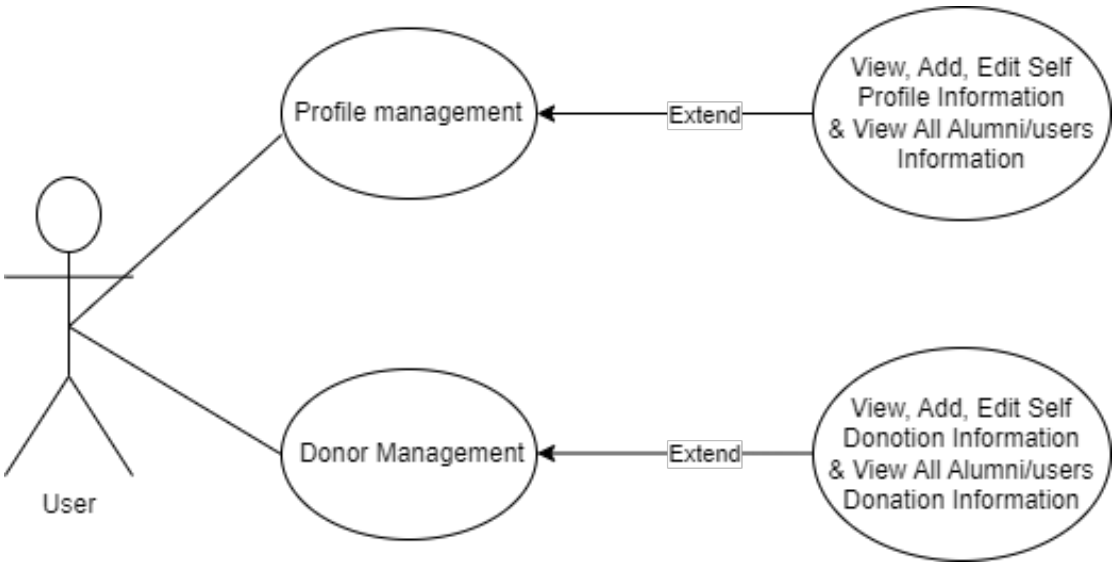

Figure 4.2: Use case diagram of User.

4.4.3 Use case diagram of Admin

Figure 4.3 illustrates the use case diagram for the User. In this system, a general user can perform several actions, primarily focused on finding donor-related information.

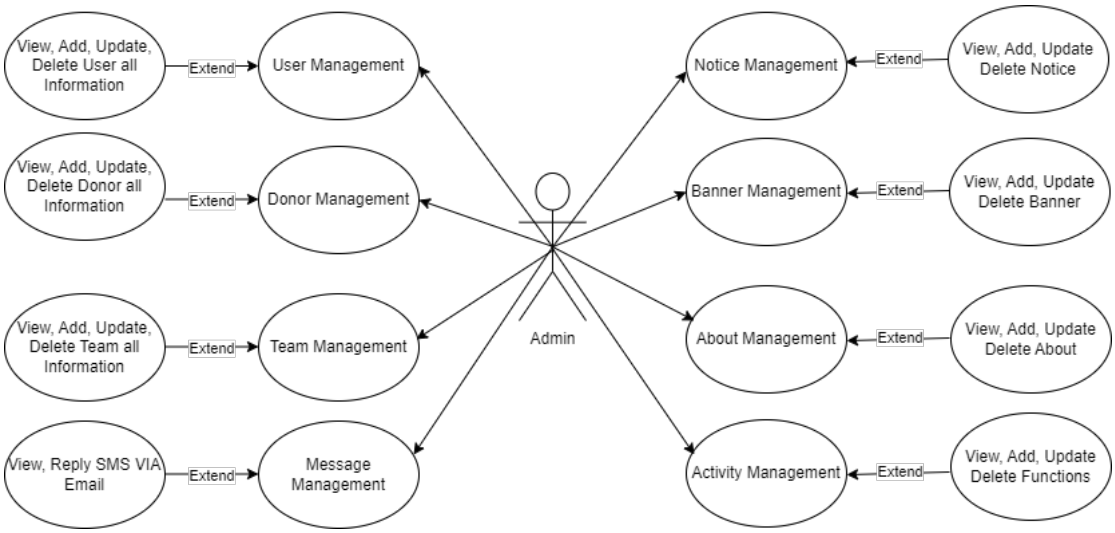

Figure 4.3: Use case diagram of Admin.

4.5 System Features

This Online System is developed with all the essential features codes are written and all the features are implemented. Screenshots of some of the main features are described bellow.

4.5.1 Home Page

The **Home Page** serves as the main entry point of the Alumni Connect & Blood Donation Management Platform. It provides users with quick access to core features and navigation menus, ensuring a user-friendly experience for both first-time visitors and registered members. Users/Public can search for blood donors directly from the homepage by selecting a blood group, location, and checking availability status. This allows quick access to relevant donor information without needing to login. The homepage includes the following menu items:

- **Home:** Navigates users back to the main page, which features the donor search tool and general information about the platform.

- **About Us:** Offers an overview of the platform's purpose, mission, vision, and the team responsible for its development.
- **Function:** Highlights the core features of the system, including alumni networking, blood donor management, and user interactions.
- **Notice:** Displays important announcements, alerts, and updates related to alumni events, system maintenance, or organizational news.
- **Pages (Dropdown Menu):**
    - **Blood Donation:** Provides detailed information on donor eligibility and lists of available donors.
    - **Activity:** Showcases recent events, campaigns, or activities organized through the platform.
    - **Team:** This section showcases the alumni who have been elected to serve on the team, highlighting their responsibilities, roles, and contributions in managing and supporting the platform. It reflects the collaborative and representative nature of alumni involvement in the system's development and operations.
    - **Contact Us:** Offers contact details and a form for users to send inquiries or feedback.
    - **Comment:** Allows users to submit feedback about their experience using the platform.
- **Signup / Login:** Enables new users to register or existing users to log in for access to features such as profile management, donor registration, and donation request history.

The homepage is designed to be responsive, user-friendly, and informative, ensuring that users can easily access services and locate the information they need.

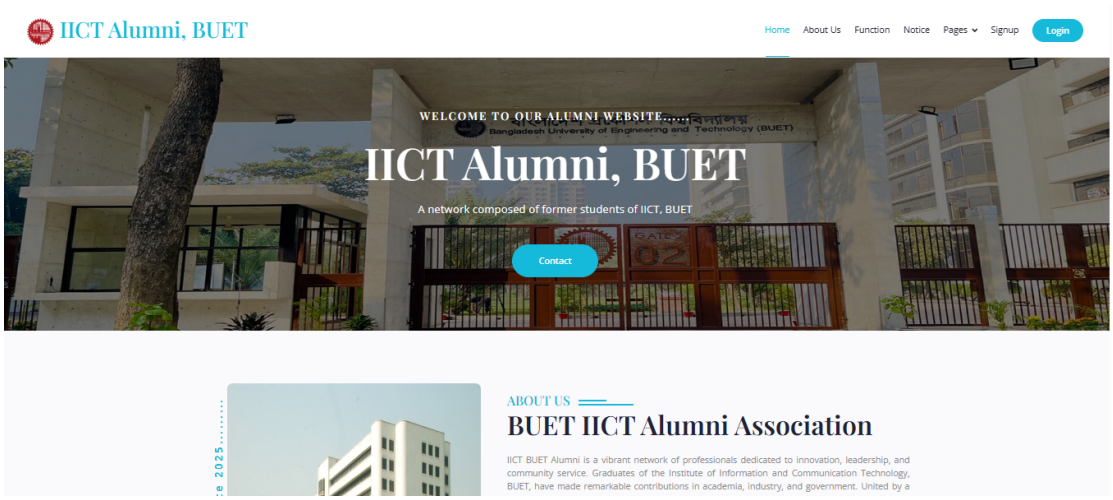

Figure 4.4: Home Page.

4.5.2 Public search donor page

The platform enables the general public to search for available blood donors directly from the homepage, without requiring a login. Users can perform a search by specifying criteria such as donor name, blood group, contact information, donation date, and availability status. Once the criteria are entered, the system presents a list of matching donors along with essential details, including:

- **Donor Name**
- **Contact Number**
- **Blood Group**
- **Location**
- **Last Donation Date**
- **Availability Status**

This functionality allows people in urgent need of blood to quickly locate and reach out to available donors, using up-to-date information to enhance response times and accessibility during critical situations.

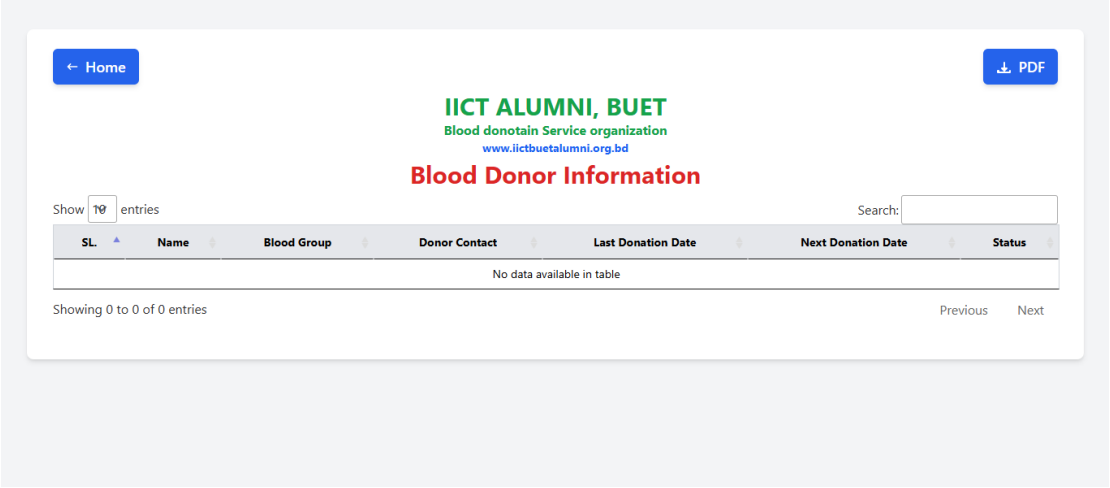

Figure 4.5: Search Donor List Information.

4.5.3 Registration page

The Registration Page enables new users to create an account on the Alumni Network and Blood Donation Management Platform. It features a user-friendly layout, organized to collect all necessary personal and contact information needed for membership in the system.

Key features of the Registration Page include:

- **Personal Information:**
  - Full Name
  - Student number
  - Department
  - Passing Year
  - Email Address (used as username)
  - Phone Number
  - Date of Birth
  - Gender
- **Blood Donation Information:**
  - Blood Group
- **Account Credentials:**

  - Password

- **Location Details (Current and Permanent):**
  - Division
  - District
  - Upazila/Area
- **Profile Picture Upload (optional):**
  Users have the option to upload a profile picture, allowing them to personalize their account and make their profile easily identifiable.
- **Profession Information (optional):**
  - Job Title
  - Designation
  - Office Contact
  - Office Name

At the bottom of the registration form, users can select the “Sign Up” button to submit their details or the “Reset” button to clear all entries. A link is also provided for existing users to navigate to the Login Page. The form incorporates validation to ensure all required fields are properly filled and that passwords match. After successful registration and activation by an administrator, users can log in to access personalized features, including updating their profile, managing donation records, and responding to blood donation requests.

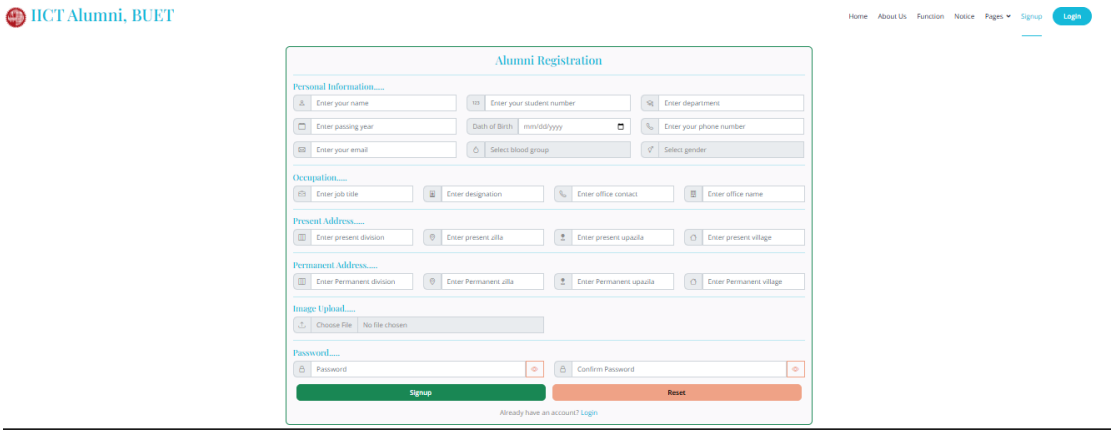

Figure 4.6: Registration Page.

4.5.4 Login page

The Login Page offers a secure entry point for registered users to access the Alumni Network and Blood Donation Management Platform. It features a simple and user-friendly design, enabling users to quickly log in and reach their personalized dashboard. Key Features of the Login Page:

- **Login Form Fields:**
  - **Email or Username:** Email or Username used to identify the system registered alumni or user.
  - **Password:** A password that is securely linked to the user's account to protect access and maintain account confidentiality.
- **User Feedback:**
  - Notifications are shown to inform users when the login credentials entered are incorrect.
  - The system checks that all required fields are completed before allowing the form to be submitted.
- **Additional Options:**
  - A "Forgot Password?" link is provided to allow users to start the password recovery process, typically via their registered email address.
  - A "Login" button to submit the credentials. prompt is displayed for users who do not have an account, guiding them to "Sign Up" through a direct link to the registration page.

After logging in successfully, users are taken to their personal dashboard, where they can manage their profile, search for available donors, and review their activity history. The login system safeguards user authentication, protects personal data, and enforces role-based access, ensuring that general users, alumni, and administrators can only access features appropriate to their assigned roles.

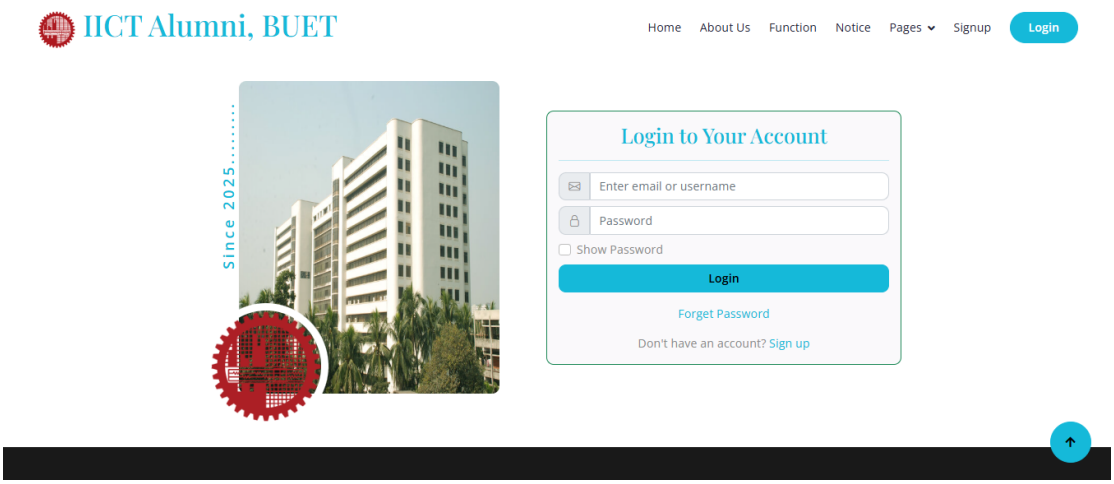

Figure 4.7: Login Page.

4.5.5 Dashboard for Admin

The Admin Dashboard is a centralized control interface reserved for users with administrative rights. It offers comprehensive tools for overseeing and managing the platform, including user accounts, content, and overall system operations.

Key Features of the Admin Dashboard:

- **User Management:**
  - Access and manage user accounts, including alumni and donors, with options to add, update, or remove entries.
  - Enable or disable user accounts as needed.
  - Set or update user roles, such as Admin, Alumni, or General User.
- **Blood Donation Management:**
  - Review the complete donation history of all donors.
  - Track donor availability for potential blood requests.
  - Add, update, or remove donor donation records.
- **Team Management:**
  - Manage team accounts with the ability to view, create, edit, or delete them.
  - Control team status by activating or deactivating accounts.
  - Assign or adjust roles within the team structure.

4.5.6 Event Management

Event Management including banner, about us, notice, executive team member, activity, gallery and function modules is allows to manage various dynamic content sections of the platform by administrator that appear on public-facing pages.

Key elements of this module:

- **Banner Management:**
  - Add or change the homepage banners.
  - Update the titles and descriptions of each banner.
- **About Us Section Management:**
  - Update web platform overview, mission, vision, and background information shown on the "About Us" page.
- **Notice Management:**
  - Add and update notices or announcements.
- **Activity Management:**
  - Add descriptions and images for past or upcoming events and activities.
  - Visible reports and outcomes of blood donation or alumni activities.
- **Gallery:**
  - Add and update images of alumni activities.
- **Team Member Management:**
  - Add and update executive team member information.

These functionalities help keep the platform's content current, engaging, and informative, allowing users to stay aware of ongoing activities and updates. The admin dashboard features an intuitive interface and well-structured layout, enabling administrators to effectively oversee and manage the system. It is essential for maintaining the platform's smooth operation, security, and overall reliability.

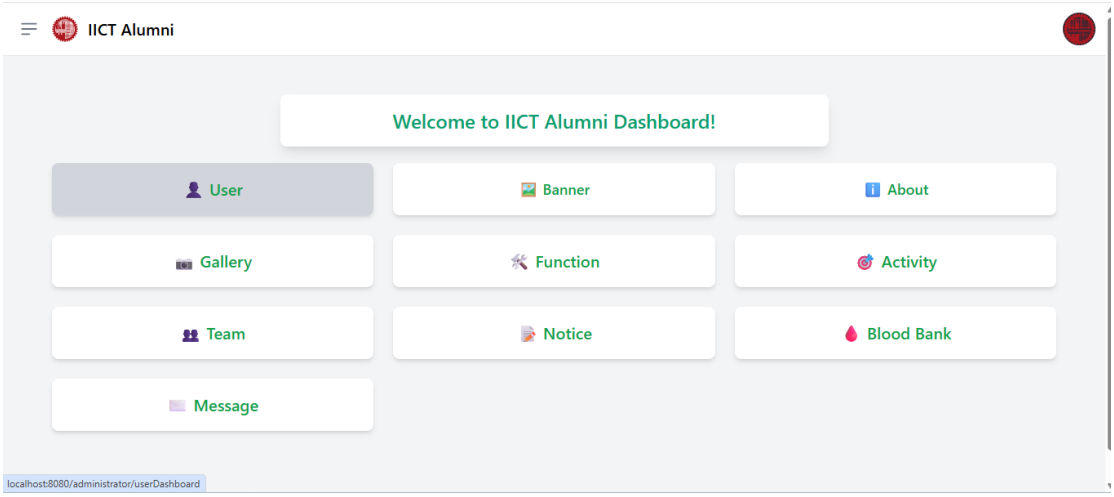

Figure 4.8: Dashboard.

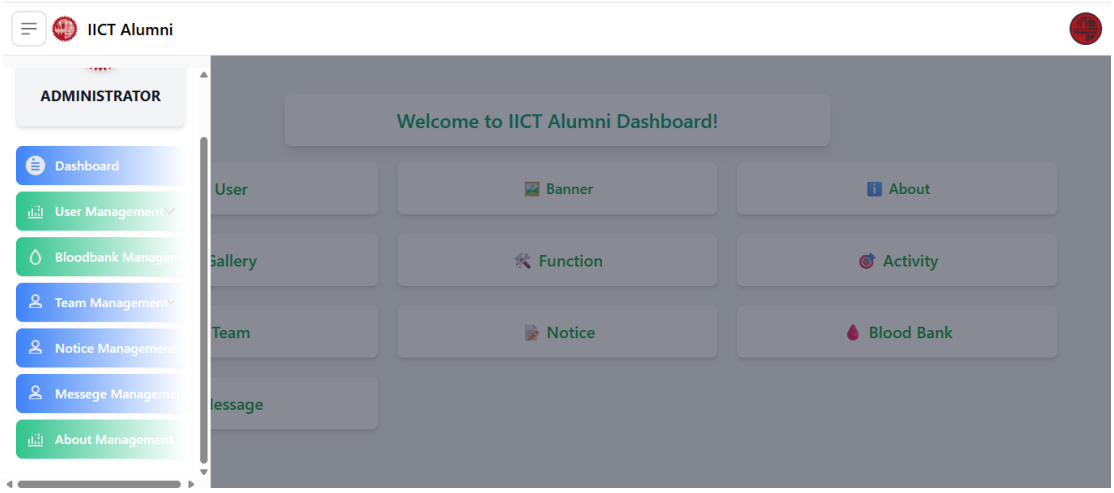

Figure 4.9: Dashboard with Submenu.

4.5.7 User List

The User List page serves as an administrative dashboard that presents a comprehensive list of all registered users, including administrators, alumni, and general members. It offers a clear and organized view of user information while providing tools to efficiently manage and maintain user accounts.

Key Features of the User List:

- **Tabular Display:** Users are displayed in a tabular format with some columns such as:
  - Name

  - Email(User Name)
  - Department
  - Roll(Student Number)
  - Passing Year
  - Phone Number
  - Status (Active/Inactive)
  - Role (e.g., Administrator, Admin, User)

- Search and Filter Options: Admins can search for users by name, department, roll, passing year, contact number role or active status.
- **Action Buttons:** Each user row includes action buttons for:
  - View: Display full profile of registered user.
  - Edit: Modify user all data such as name, department, roll, passing year, email, contact number, role, or status.
  - Delete: Remove the user information from the this system.
  - Status: Activate or deactivate the user account to availability of users access.
  - Password Reset: If alumni forget password then admin can reset user password.

The User List acts as an essential tool for administrators to oversee user activity, ensure the integrity of data, and manage role-based permissions across the platform.

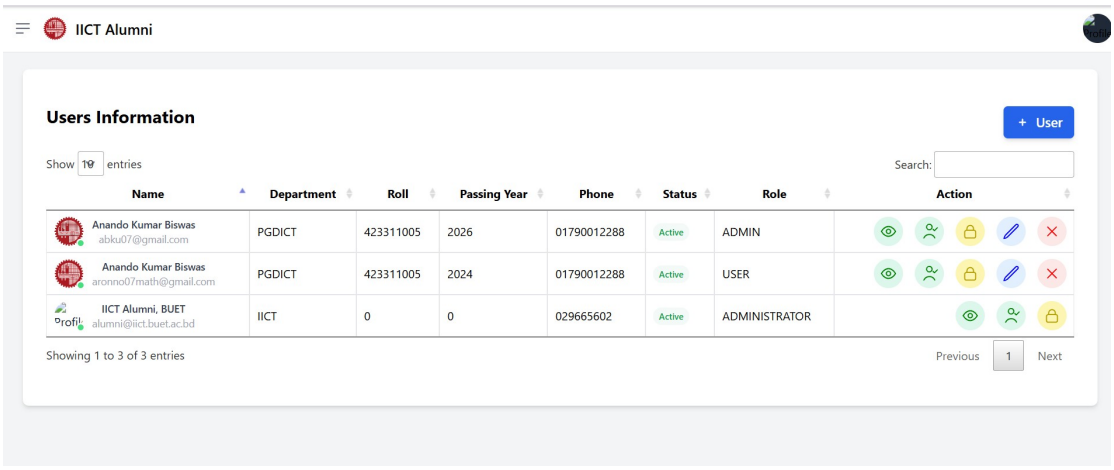

Figure 4.10: User List.

4.5.8 Donor Form

The Donor Form is designed to record the details of each blood donation performed by a registered donor. It records key information about both the donation event and the recipient, ensuring a complete and organized donation history. The form includes the following fields:

- **Donation Date:** The specific date on which the blood donation occurred.
- **Receiver Name:** The full name of the receiver who received the blood.
- **Receiver Address:** The complete address of the recipient, including hospital or locality details if relevant.
- **Receiver Contact:** Contact information, such as a phone number, for the recipient or their guardian.
- **Relation with Donor and Receiver:** Record what are the relation with donor and receiver.

This form enables precise tracking of all donations and supports efficient record management. It can be accessed and managed by administrators or authorized users, provided the alumnus has activated their donation participation status.

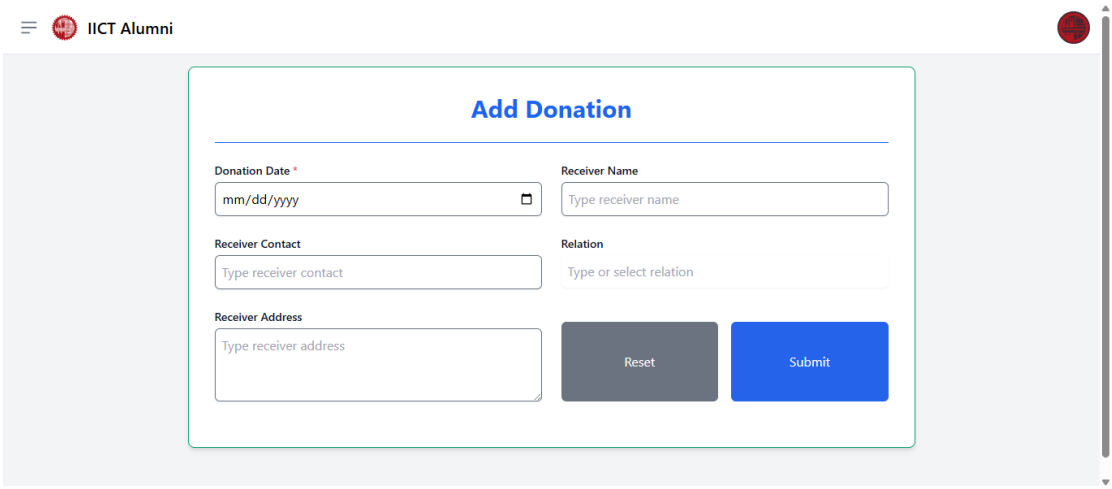

Figure 4.11: Donor Form.

4.5.9 Self Donation List

The Self Donation List is a dedicated section for registered individual donors, giving them access to a detailed record of their own blood donation activities. It enhances

enables users to monitor and reflect on their previous donation contributions.

Key Features of the Self Donation List:

- **Donation History Table:**
  - Donation Date
  - Receiver Name
  - Receiver Address
  - Receiver Contact
- **Order by Date:** Donations are organized with the newest entries appearing first, providing a clear chronological view.
- **Modify or Remove Entries:** Donors may have the ability to correct or delete inaccurate records.
- **Responsive Design:** The list is designed to be accessible and user-friendly on both desktop and mobile devices, ensuring smooth navigation across platforms.

This feature enables donors to keep a personal record of their donation activities, which can assist with medical documentation, planning upcoming donations, and monitoring how often they donate in line with eligibility requirements.

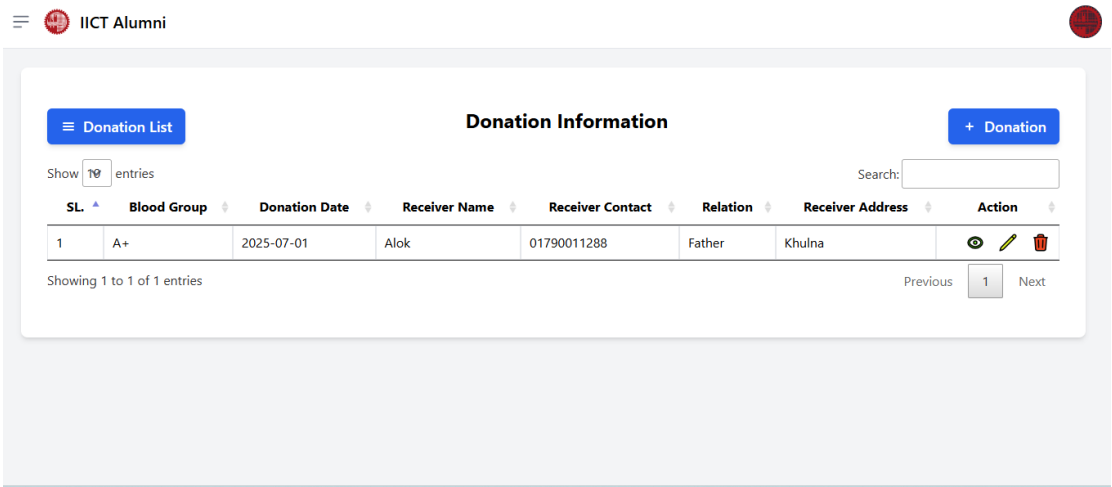

Figure 4.12: Self Donation List.

4.5.10 All Donor List

The All Donor List page displays a complete overview of every blood donor registered on the platform. It serves as a centralized location where authorized personnel, such as

administrators, can review, supervise, and manage donor information efficiently. Key Features of the All Donor List:

- **Tabular Display of Donors:**
  - Donor Name
  - Blood Group
  - Location (Division, District, Upazila)
  - Phone Number
  - Last Donation Date
  - Availability Status
- **Search and Filter Options:**
  - Search reliable donors contact information by blood group, present location, last donation date of interested donor.
  - Search by donor name or phone number to find exact donor.
- **Action Buttons (Admin Only):**
  - View Profile: See detailed donor donation history.
  - Edit: Update donor details
  - Delete: Remove donor from the list (with confirmation)
  - Change Status: Change donor interested(or not interested) status.

This page allows authorized users to access essential donor details quickly, supporting timely decisions during urgent blood requirements. It also contributes significantly to the effective management and upkeep of an active and reliable donor community.

Chapter 5

Conclusions

5.1 Conclusions

In this initiative, a web platform was created to facilitate both alumni networking and blood donation management within a unified system. This platform enables former students to set up and modify their profiles, maintain connections with fellow alumni, and systematically log their blood donation details. With user permission, donation information can be made searchable to assist in locating suitable donors when necessary. Distinct sections for users and administrators ensure that data is handled securely and effectively. The system encompasses vital features such as registration, profile management, tracking of donation history, and a donor search function, all delivered through a simple and user-friendly interface. While the current system achieves its primary goals, there is room for enhancement, including support for mobile applications, enhanced security measures, and integration with hospitals or blood banks. Overall, this project lays a strong foundation for a valuable and socially responsible platform that can continue to evolve and benefit both the alumni network and public health services.

5.2 Future Prospects of Our Work

- **Mobile Application Development:** To enhance accessibility, the platform could be expanded by developing a dedicated mobile app for both Android and iOS devices. This app would allow users to sign up, update their profiles, and monitor their donation activities with greater ease. Additionally, features like push notifications could be incorporated to alert users when they are eligible to donate again or when significant alumni events are planned.

- **Strengthened Security and Privacy:** As the platform handles sensitive personal data, future versions should introduce more robust security mechanisms. These may include implementing SSL certificates for secure communication, enabling two-factor authentication for user verification, and adopting improved data protection practices to ensure user confidentiality and system reliability.

- **Personalized User Experience:** As the platform handles sensitive personal data, future versions should introduce more robust security mechanisms. These may include implementing SSL certificates for secure communication, enabling two-factor authentication for user verification, and adopting improved data protection practices to ensure user confidentiality and system reliability.

- **Full Integration of Online Payment Services:** Although the current features may only allow for basic payment demonstrations, upcoming versions could potentially include full integration with popular digital payment platforms like bKash, Nagad, credit and debit cards, and PayPal. This enhancement would enable seamless and secure processing of payments for donations, event fees, and other financial transactions.

- **Location-Based Donor Discovery:** A geolocation feature could be added to help users quickly find donors nearby during emergencies. By using real-time location data, the system would be able to display the closest eligible donors, improving the speed and effectiveness of donor-search operations.

- **Collaboration with Healthcare Institutions:** Future enhancements may include direct integration with hospitals and blood banks. This would allow real-time sharing of blood availability data and improve coordination between donors, recipients, and healthcare facilities, ultimately making the donation process more efficient and reliable.

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