A PROJECT REPORT

on

Web-Based Blood Bank Management System

Submitted To:

Department of Information Technology

Central Campus of Technology

Hattisar, Dharan

In partial fulfilment of the requirements for the degree of Bachelor's of Information Technology (BIT)

Submitted By:

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[September, 2025]

SUPERVISOR RECOMMENDATION

This is to recommend that **Mr. Bipson Mukhiya**, Symbol No. BIT 617/078, **Mr. Namchhahang Rai**, Symbol No. BIT 621/078 and **Mr. Prajan Tamang**, Symbol No. BIT 623/078 has carried out project work entitled "**Web-Based Blood Bank Management System.**" for the requirement to the project work in Bachelor of Information Technology (BIT) under my supervision in the Department of Information Technology, Central Campus of Technology, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal.

To my knowledge, this work has not been submitted for any other degree. They has fulfilled all the requirements laid down by the Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal for the submission of the project work for the partial fulfillment of Bachelor of Information Technology.

_____

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DECLARATION

This project work entitled " **Web-Based Blood Bank Management System.** " is being submitted to the Department of Information Technology, Central Campus of Technology, Institute of Science and Technology (loST), Tribhuvan University (T.U.), Nepal for the partial fulfillment of the requirement to the project work in Bachelor of Information Technology (BIT) degree. This project work is carried out by me under the supervision of Mr. Prakash Neupane T.U., Department of Information Technology, Central Campus of Technology, Institute of Science and Technology (loST), Tribhuvan University (T.U.), Nepal.

This work is original and has not been submitted earlier in part or full in this or any other form to any university or institute, here or elsewhere, for the award of any degree.

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CERTIFICATE OF APPROVAL

This project work entitled " **Web-Based Blood Bank Management System** " by Mr. Bipson Mukhiya [BIT 617/078], Mr.Namchhahang Rai [BIT 621/078] and Mr. Prajan Tamang [BIT 623/078] and T.U. under the supervision of Mr. Prakash Neupane in the Department of Information Technology, Central Campus of Technology, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), is hereby submitted for the partial fulfillment of the Bachelor of Information Technology (BIT) degree . This report has been accepted and forwarded to the Exam Section, Office of the Dean, Institute of Science and Technology, Tribhuvan University, Nepal for the legal procedure.

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ABSTRACT

This report discusses the creation and use of the Blood Bank Management System, which is a web-based tool meant to make it easier to get blood during emergencies and manage blood resources more effectively. The software is designed for administrators, donors, patients, and hospitals, offering a single place to handle important blood management issues. The system helps solve problems like not having enough blood available quickly, not enough registered donors, shortages of rare blood types, low patient awareness, and the hassle patients face when getting blood from different health centers.

The system has several important features, including secure login with different access levels for users, full registration for donors and volunteers, efficient tracking of blood supplies with automatic warnings when blood levels are low or close to expiring, and easy processing of donation requests by matching donors with the right blood types. It also allows users to search and filter records, plan donation events, and create reports. The system was built using Agile methods, with the front-end made using HTML, CSS, and EJS, and the back-end powered by NodeJs and MySQL. The Blood Bank Management System helps improve healthcare by ensuring safe, tested blood is available on time and encourages more people to donate blood by making the process easier and more engaging.

Keywords: HTML, CSS, EJS, NodeJs, MySQL, Blood Bank Management, Donor Management, Web-based System, Agile Methodology.

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

QA Quality Assurance

CSS Cascading Stylesheet

EJS Embedded JavaScript

GUI Graphical User Interface

HTML HyperText Markup Language

JS JavaScript

MySQL My Structured Query Language

NodeJs Node.js

SN Serial Number

OS Operating System

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 Introduction

Blood supplies essential oxygen and nutrients to all cells and tissues and is a vital part of immune defense and healing. Millions of lives are saved each year through transfusion of safe blood and blood products, and more than 118 million units of blood are donated each year to meet a demand for the essential products and services[1]. Even in the United States, United States million 24 million units of blood-derived products are transfused every lifesaving support to patients in surgery, trauma, cancer the treatment of chronic diseases, etc. chronic diseases, etc. [2].

Blood transfusion is a vital component of today's medicine, especially in an emergency case where a patient has an acute blood loss, such as accidents, surgeries and medical failures[3]. Due to the special properties of this blood, its limited shelf life, and the inability to produce it synthetically, blood banks are essential components of the health care system [4]. These dedicated sites are involved in the collection, testing, processing, and storage of blood components, such as red blood cells, platelets, plasma and other crucial blood products to support the safe and timely delivery of blood to patients in need [5].

Although the need for blood is the key, all health care systems around the world have to grapple with the problem of keeping sufficient blood stocks. According to the World Health Organization (WHO), there are significant differences between blood donation rates from country to country; while in high-income countries the rate is 31.5 donations per 1000 people per year, in low-income countries only 5.0 per 1000 are donated[1]. This discrepancy, along with a higher age of the donor population and increasing medical needs, exerts pressure on blood bank systems to improve and efficiently manage supply and accessibility [6].

Critical healthcare interventions can be held up as result of inefficiencies in donor recruitment, tracking of inventory, and emergency response coordination how plague traditional blood bank management systems. Given such challenges, development of a comprehensive blood bank management system is crucial to bridging the divide between healthcare facilities, donors, and recipients. By streamlining and digitizing blood management procedures, this web-based technological solution supports the core goal of saving human life through effective blood resource management [7] for certifying that life-saving blood products are available when and where they are most needed.

1.2 Problem Statement

Healthcare systems around the world have embraced technological solutions to address important operational challenges as a result of the rapid modernization and digital transformation taking place on a global scale. In developing countries like Nepal, the Information Technology sector has emerged as a crucial catalyst for healthcare advancement, particularly in life-critical services such as blood bank management [8]. Inadequate record-keeping procedures, poor stakeholder communication, and major inefficiencies have resulted from traditional methods of managing blood

donation and distribution systems, endangering patient safety and operational effectiveness [6].
A comprehensive digital platform that offers blood bank administrators accurate and useful information about the whole blood collection, storage, and distribution scenario across different medical centers and regions has been lacking in Nepali healthcare facilities [9]. Lack of such digital infrastructure results in disjointed supply chains between patients, healthcare facilities, and blood donors, which can cause significant holdups and potentially deadly blood supply waste, particularly when there are situations of emergency. There isn't a single digital platform that enables patients, donors, and healthcare professionals to quickly and easily communicate their needs, availability, and concerns to the right authorities.
Inadequate donor recruitment systems, inconsistent blood supply availability, and a lack of real-time inventory tracking across blood banks pose serious issues for the population at large. Inefficient donor-recipient matching and delayed emergency response are two consequences of traditional blood donation management processes, which tend to depend on manual record-keeping, phone calls, and paper-based documentation [10]. These difficulties are made worse by the high rates of infectious diseases and anemia in developing nations, which both raise the need for blood transfusions and decrease the pool of possible donors [6].
A safe and sufficient supply of blood is currently severely compromised via financial limitations and lack of facilities in developing nations, where many areas rely primarily on family replacement donors rather than voluntary donations [6]. Blood banking operations are fragmented and unable to meet the urgent healthcare needs of communities due to a lack of national blood transfusion policies, digital management systems, trained personnel, and appropriate technological infrastructure. Traditional blood management techniques have been rendered hard by worries about donor privacy, data security, and the lack of extensive databases to track blood donations and stocks.
The urgent need for a comprehensive digital solution that can transform blood bank operations through technology integration is highlighted by these systemic problems. By offering healthcare authorities automated inventory management, real-time digital oversight of blood distribution patterns, and streamlined communication channels between all stakeholders in the blood donation ecosystem, our Web-Based Blood Bank Management System is intended to address these pressing issues [11, 12].

1.3 Objectives

The main objectives of this project are as follows:

- To improve blood accessibility by providing quick online access to availability and emergency needs, reducing delays in critical treatments.
- To streamline blood procurement through a centralized system that minimizes the need for patients to visit multiple health centers.

1.4 Scope and Limitation

1.4.1 Scope

- Can get all information of available blood in the stock.
- Time-saving
- Easy Search for available blood
- Space for further modification

1.4.2 Limitations

- The system is used by blood banks/centres only as it contains required blood,donors, patients information.
- This system is available online only. Offline, it cannot be used.
- Only web-based system is available. No mobile based system available.
- Without proper informations it is very difficult to supply blood to the required people.

1.5 Development Methodology

In our project, Agile methodology is used, which is adaptable and iterative in software development and quickly aligns with the changing needs of our Blood Bank Management System. Agile

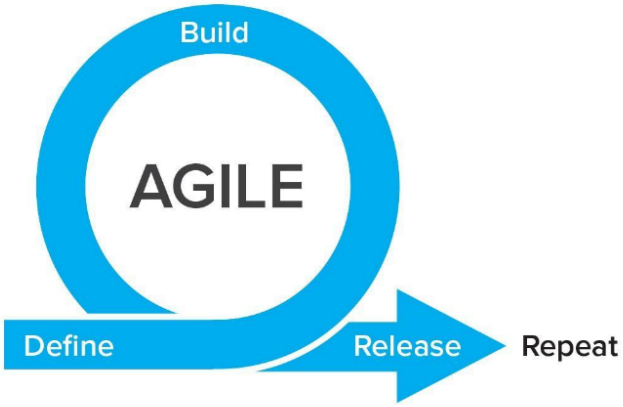

Figure 1.1: Agile Methodology

places a high value on teamwork, flexibility, and client input, which enables us to quickly adapt to changing demands as they arise throughout the development process. We can consistently deliver useful and functioning components by dividing the project into short, manageable units called sprints. Using an iterative method, the development team can remain adaptable to changing priorities, regularly involve stakeholders, and foster a culture of continuous improvement. The focus

of Agile methodology on incremental development, frequent reevaluation of objectives, and teamwork is exactly in line with our project's objective of developing a flexible and effective blood bank management system [13].

Agile's iterative structure gives us early and regular feedback, which makes it easier to quickly incorporate changes. This flexibility is essential in the healthcare industry, as prompt answers to new requirements can have a big influence on patient outcomes. We make sure that our development process is not only effective and responsive, but also in line with the changing needs of the healthcare industry by adopting the Agile methodology.

1.6 Report Organization

This report is organized into six chapters for systematic presentation. Chapter 1 introduces the project and its objectives. Chapter 2 presents the literature study and related works. Chapter 3 discusses system analysis, including requirements and feasibility. Chapter 4 focuses on system design, describing architecture and modeling. Chapter 5 covers implementation and testing of the system. Finally, Chapter 6 provides the conclusion along with recommendations for future enhancements.

CHAPTER 2: BACKGROUND STUDY AND LITERATURE REVIEW

2.1 Background Study

A lack of eager donors and delayed access to vital blood supplies have made managing blood resources in the current healthcare environment difficult [14, 15]. It is now necessary to take a revolutionary strategy because traditional methods have not been able to meet patients' urgent and changing requirements [16]. In-depth analysis of the current blood bank management systems is provided by this background study, which points out the need for a more adaptable and advanced technological solution that will not only facilitate seamless connections between donors and recipients but also inform and involve the community in the blood donation process [17].

The need for a thorough blood bank management system is highlighted by the frequency of low donor registrations and the paucity of uncommon blood kinds [18]. The suggested system strives to make use of the Agile methodology, recognizing the shortcomings of conventional ways and encouraging cooperation, adaptation, and continual improvement [13]. The technology aims to transform the blood banking process by introducing elements like real-time tracking, community partnerships, and a user-friendly mobile app [19]. This will make the platform more effective, transparent, and easily accessible for both healthcare providers and donors. In the end, the Blood Bank Management System hopes to contribute to a more robust and responsive healthcare ecosystem by addressing the systemic issues in blood management through this creative method [20].

2.2 Literature Review

This study conducts a critical analysis of the current web-based blood bank information systems, emphasizing platforms that are pertinent to the Nepali environment [21, 22]. Two websites, BloodLine and Hamro Life Bank, which are obtained from phpgurukul.com and studocu.com, are the main focus of the review [21, 22]. Both platforms are web-based blood management systems created to make it easier to handle donor records and distribute blood products throughout the nation's numerous regions.

The study reveals major weaknesses even as it acknowledges the positive aspects of the websites under assessment, such as their ability to facilitate donor record maintenance and provide ease of control for blood product delivery [17, 20]. The current platforms don't have features that allow people to sign up as volunteers for contribution initiatives, nor do they have a national assurance mechanism. Furthermore, the systems under study do not provide thorough details about the conditions and procedure for blood donation [18].

This plan presents an alternative strategy in response to these deficiencies. A well-thought-out website, donor registration features, and an extensive information section covering the necessary requirements and procedure for blood donation set apart the project's system [13, 19]. These improvements add to the project's dependability and educational value by providing donors and blood bank administrators with a more comprehensive and user-friendly experience [15].

CHAPTER 3: SYSTEM ANALYSIS

3.1 System Analysis

The proposed system is designed to help the Blood Bank administrator to meet the demand of Blood by sending and/or serving the request for Blood as and when required [20, 17]. The proposed system gives the procedural approach of how to accommodate the gap between Recipient, Donor, and Blood Banks. This system will provide a common ground for Recipient, Donor, and Blood Banks [18]. The system is a web based online application that provides the user with the facility of detailed information of Donor or Blood request and clears the factor of confusion from user mind about information. Even this is used to make conveniently available good quality blood and other blood components, which can be provided in an acceptable manner, consistent with the long-term wellbeing of the community [19, 15]. So, every effort is taken to implement this project in the blood bank as it actively encourages voluntary blood donation, motivate and maintain a well-managed record of blood donors and educate the community on the benefits of blood donation [14].The proposed system is used as it provides a detailed information platform to the user, the manual system is replaced with the online system and all the data and the record are stored safely in the database in this system [23, 24].

3.1.1 Requirement Analysis

The known requirements of this system are divided into two categories (functional and non-functional) and are mentioned below:

Functional Requirement

Below is the use case diagram for this system.

i. User Authentication:

- Users (donors, patients, blood banks, administrators) must have secure authentication.
- Role-based access control to ensure appropriate system access.

ii. Donor Registration:

- Users should be able to register as donors, providing personal details, contact information, blood type, and donation history.
- The system must validate and securely store donor information in the database.

iii. Volunteer Registration:

- Volunteer registration functionality for individuals interested in participating in donation programs and social activities.

iv. Blood Stock Management:

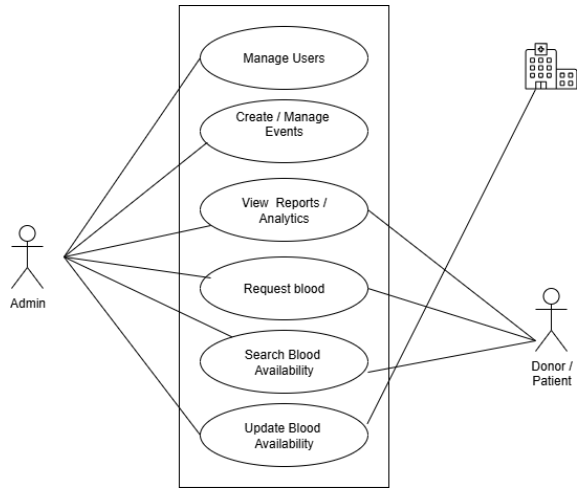

Figure 3.1: Use case Diagram

- Blood banks should have the ability to manage and update blood stock inventory, including details like blood type, quantity, and expiration date.
- Automated alerts for low stock levels and expiring blood.

v. Donation Request Handling:

- Hospitals and other users should be able to submit blood donation requests.
- The system should automatically match donor availability and blood type with incoming requests.

vi. Search and Filtering:

- Administrators and user should have tools for searching and filtering donor records, volunteer information, and specific blood types.

vii. Event Management:

- Admin control for creating and managing blood donation events, specifying details such as date, time, and location.

Non-Functional Requirements

- Availability: Since it is web-based system so avail online.
- Security: Authentication is given to users and admins only. Without Verification no outsider can logged in to system. So data can be secure.
- Reliability: Since this system focuses on datas privacy, it will be reliable to keep information.
- Performance: This system will be developed for smooth performance for good response and request

3.1.2 Feasibility Analysis

Feasibility study is the research/study which is to see if the system on completion will serve the purpose of the organization for the amount of the work, effort and the time that spend on it. Feasibility study lets developer for see the future of the system and the usefulness. A feasibility study of the system proposal is according to its workability, which is the impact on the organization, ability to meet their user needs and effective use of resources.

i. **Technical Feasibility Study**
   The system is developed focusing on users/donors privacy so is more secure and reliable. Not much technological hurdle is occurred and accurate enough to use. The proposed system is developed using HTML, CSS, JS as front-end tool and Node Js, MySQL as the back end. The proposed system needs a Web Server to serve the requests submitted by the users. The Web browser is used to view the web page that is available within the Windows operating system itself. As Windows is very user friendly and GUI OS it is very easy to use. All the required hardware and software are readily available in the market. Hence the system is technically feasible.

ii. **Operational Feasibility Study**
   This study helps to provide sufficient support for the user/donors. Simple technologies are used so easy to maintain. Also works properly as it is being developed and implemented. The proposed system is operationally feasible because of the following reasons:

   - The users are benefited more as most of their time is saved.
   - he users are serviced at their place of work and the cost of the proposed system is almost negligible when compared to the benefits gained.

iii. **Economic Feasibility Study**
   This project and its concept are completely obedient of laws. It respects users privacy and running such websites are not illegal in the target area. The monetary transaction does not actually happen through the system, so no laws related to tax gets attracted here. So, the project is legally feasible.

iv. **Schedule**
   It is the measure of how reasonable the project time table is or the deadline is reasonable or not. During the lack of time or the time become mandatory, we must finish the project within a given time period as mention in Figure 3.2.

3.1.3 Object Oriented Analysis

The project utilizes different modeling techniques to represent various aspects of the system. Object modeling is carried out using class and object diagrams to define the systems structure and relationships among entities. Dynamic modeling is achieved through state and sequence diagrams, which illustrate the systems behavior and interactions over time. Similarly, process modeling is performed using activity diagrams to represent the workflow and overall process of the system.

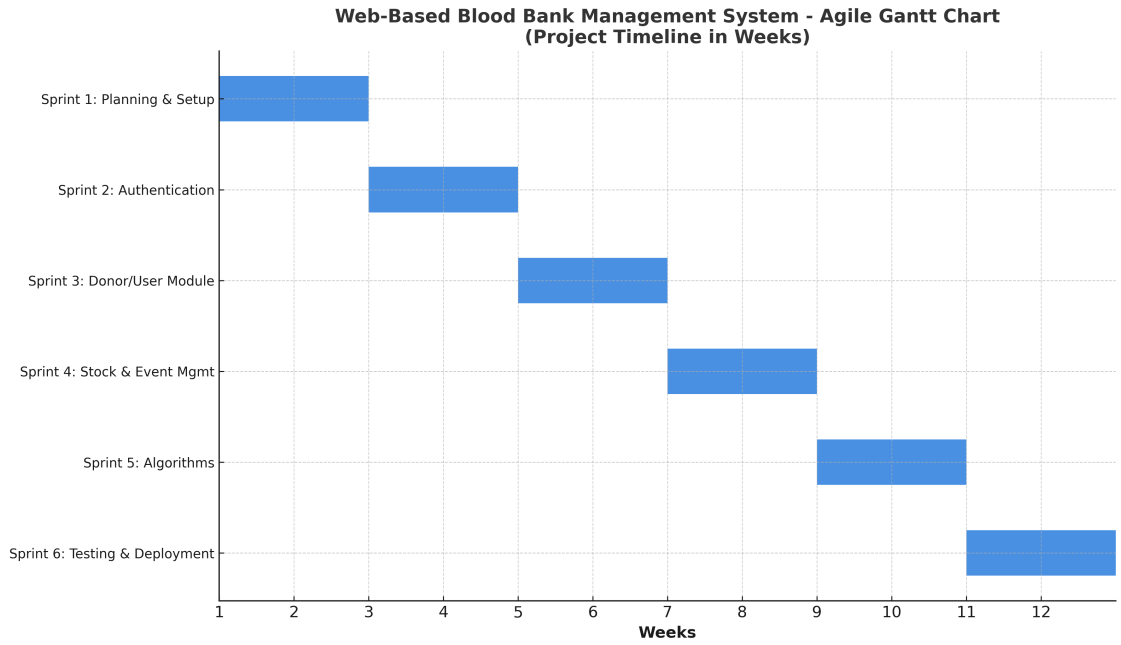

Figure 3.2: Agile Gantt Chart for Blood Bank Management System

Object Modeling

Object modeling in the Blood Bank Management System is represented through Class and Object diagrams (Fig. 3.3 and Fig. 3.4). The Class Diagram (Fig. 3.3) captures the static structure of the system, illustrating the primary entities such as Donor, Recipient, BloodBank, Administrator, and their attributes and operations. Relationships between classes, including associations and inheritances, depict how different entities interact and depend on each other. This detailed blueprint forms the foundation for system implementation by clearly defining responsibilities and data flow.

Dynamic Modeling

The Object Diagram (Fig. 3.4) complements the Class Diagram by showing an instance-level view, representing actual objects and their relationships at a particular point in time. It provides concrete examples of class instances such as specific donors or blood stock entries, helping visualize the runtime structure and system state. Together, these diagrams aid developers and stakeholders in understanding system components, data encapsulation, and interactions, ensuring a robust and maintainable design.

Dynamic modeling of the system is illustrated using State and Sequence diagrams (Fig. 3.5 and Fig. 3.6), which capture the behavioral aspects of the Blood Bank Management System. The State Diagram (Fig. 3.5) defines the lifecycle of critical system components such as the Admin, highlighting states like login, managing stock, and event coordination. This model details transitions triggered by events, ensuring accurate tracking of system status changes and user interactions over time.

The Sequence Diagram (Fig. 3.6) presents the interaction flow for specific functionalities, such as processing a blood donation request. It describes how objects, including donors, hospitals,

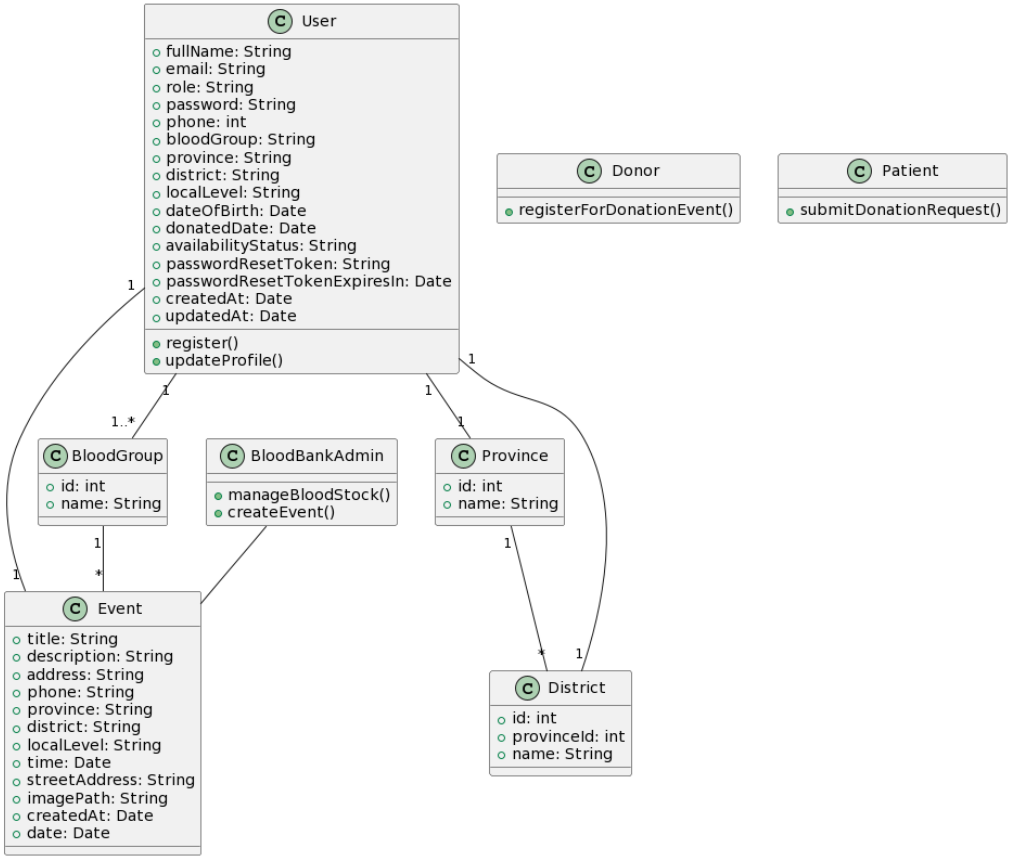

Figure 3.3: Class Diagram of Blood Bank Management System

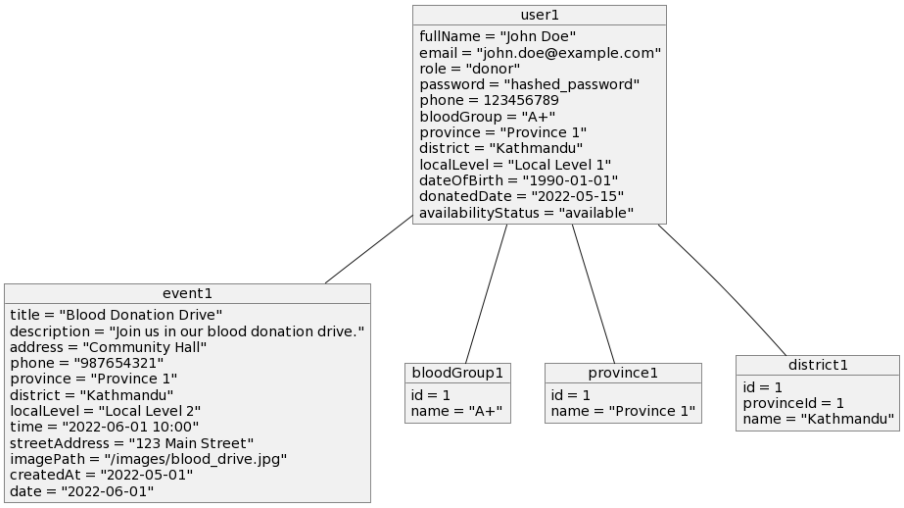

Figure 3.4: Object Diagram of Blood Bank Management System

and the system, communicate sequentially to fulfill processes. This diagram emphasizes message exchange and timing, providing clarity for the implementation of system workflows and ensuring efficient coordination between components.

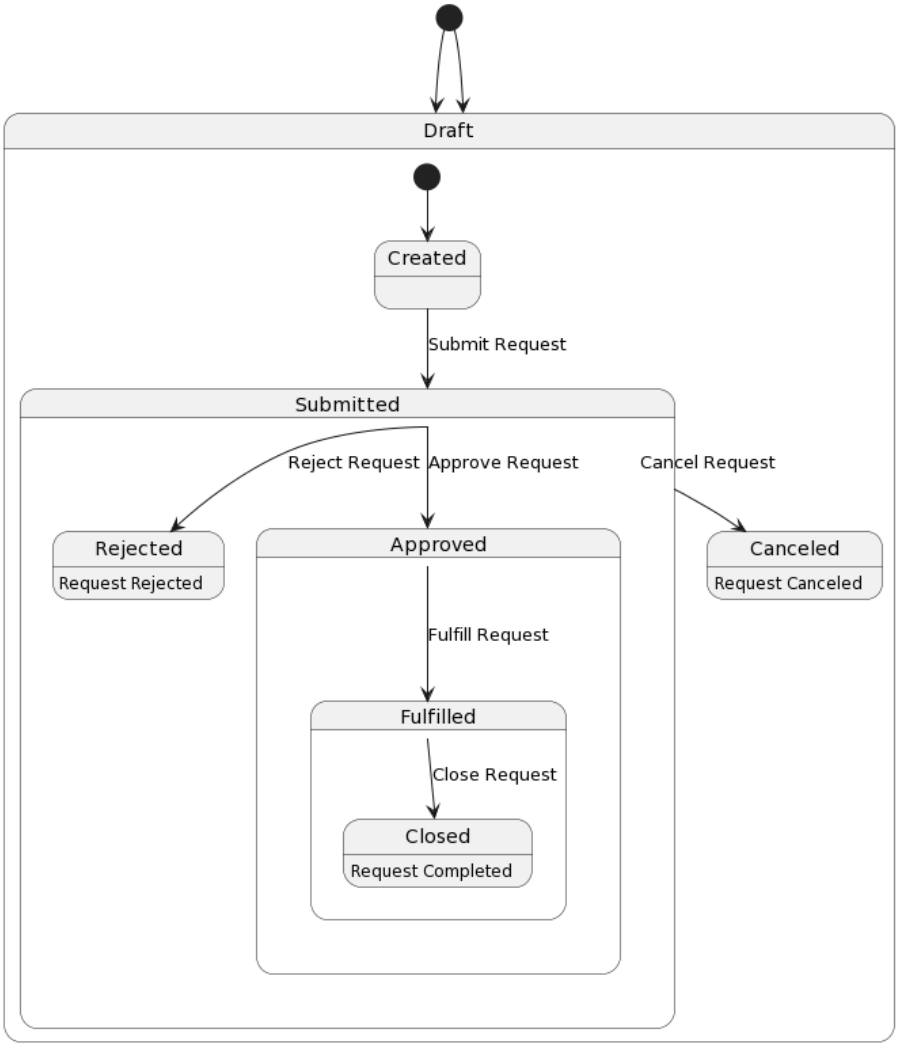

Figure 3.5: State Diagram for Admin in Blood Bank Management System

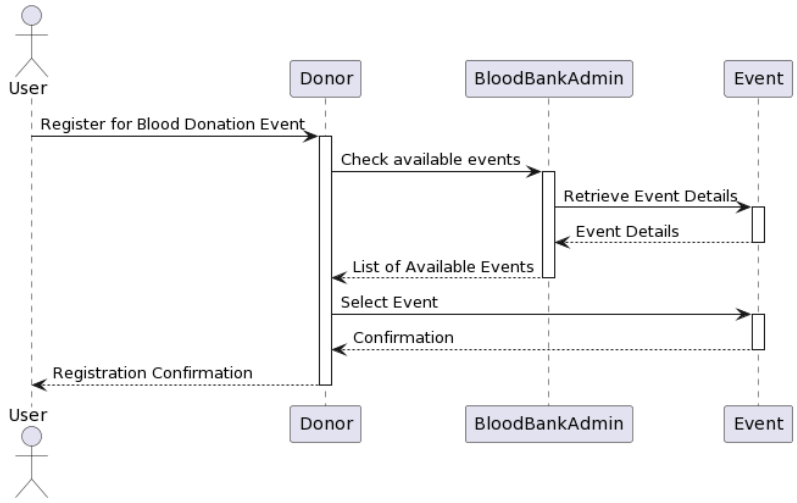

Figure 3.6: Sequence Diagram for Blood Donation Request Process

Process Modeling

The Activity Diagram (Fig. 3.7) models the workflow of key processes in the Blood Bank Management System, specifically focusing on user actions and system responses. It depicts the sequential

flow and decision points involved when a user interacts with the system for blood donation or request management. Activities such as user registration, request submission, verification, and notifications are clearly illustrated, highlighting concurrency and synchronization where applicable.

This process-centric view enhances understanding of operational procedures and potential bottlenecks, providing stakeholders a comprehensive insight into system usability and efficiency. Consequently, the Activity Diagram serves as an essential tool for both developers and analysts in designing streamlined and user-friendly interactions within the system.

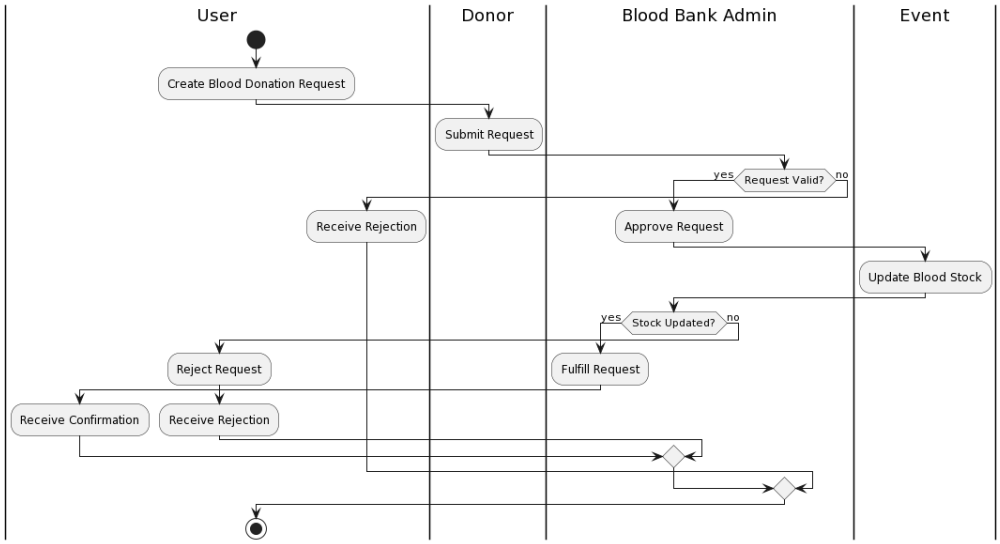

Figure 3.7: Activity Diagram for User Interaction in Blood Bank Management System

CHAPTER 4: SYSTEM DESIGN

4.1 System Design

The backbone of the Blood Bank Management System's development is system analysis, making it easier to fully understand the constraints and requirements that determine the system's operation [25]. Successful administration of the donation of blood, inventory, and dissemination depends on a comprehension of essential user roles, interactions, and data flow [20, 17]. By addressing important health concerns like donor management, emergency response coordination, and timely blood availability, the analysis phase makes sure the system enhances user satisfaction and operational efficiency. Moreover, the analysis emphasizes both functional and non-functional requirements, ensuring security, reliability, and smooth performance in a web-based environment [23, 24]. In order to maintain data integrity while promoting voluntary blood donation, a proposal is made to bridge gaps between donors, recipients, and blood banks through thorough modeling using use case diagrams, class diagrams, and process workflows [26]. By following best practices in healthcare information systems, this methodical approach guarantees that the Blood Bank Management System is secure, scalable, and responsive to the evolving demands of medical emergencies [27, 13].

4.1.1 Refinement of Class, Object, and Sequence Diagrams

The refinement of the Class Diagram provides a more detailed and precise static structure of the Blood Bank Management System. It defines essential elements such as classes, attributes, methods, and relationships including associations, inheritances, and dependencies. This enhanced model offers a clearer understanding of the systems components, their interactions, and data organization, which is crucial for accurate system development and future scalability. Furthermore, it ensures that the design phase aligns closely with both functional and non-functional requirements.

The Object Diagram represents specific, concrete instances of the classes at a particular moment in the systems execution. It demonstrates how objects interact and relate during runtime, thereby validating the defined class structures. This helps to confirm the systems dynamic correctness from the perspective of data flow and state management. Additionally, object diagrams serve as a practical tool for visualizing real-time system behavior and testing class relationships under different scenarios.

The refined Sequence Diagram illustrates the chronological sequence of interactions among objects for specific use cases. It details message exchanges, method calls, and responses in a time-ordered manner. This diagram captures the dynamic behavior of the system and assists in designing efficient workflows for critical processes such as donor registration, blood donation requests, stock updates, and report generation. Moreover, it enhances traceability by linking requirements to design components, ensuring that system processes are both optimized and aligned with user needs.

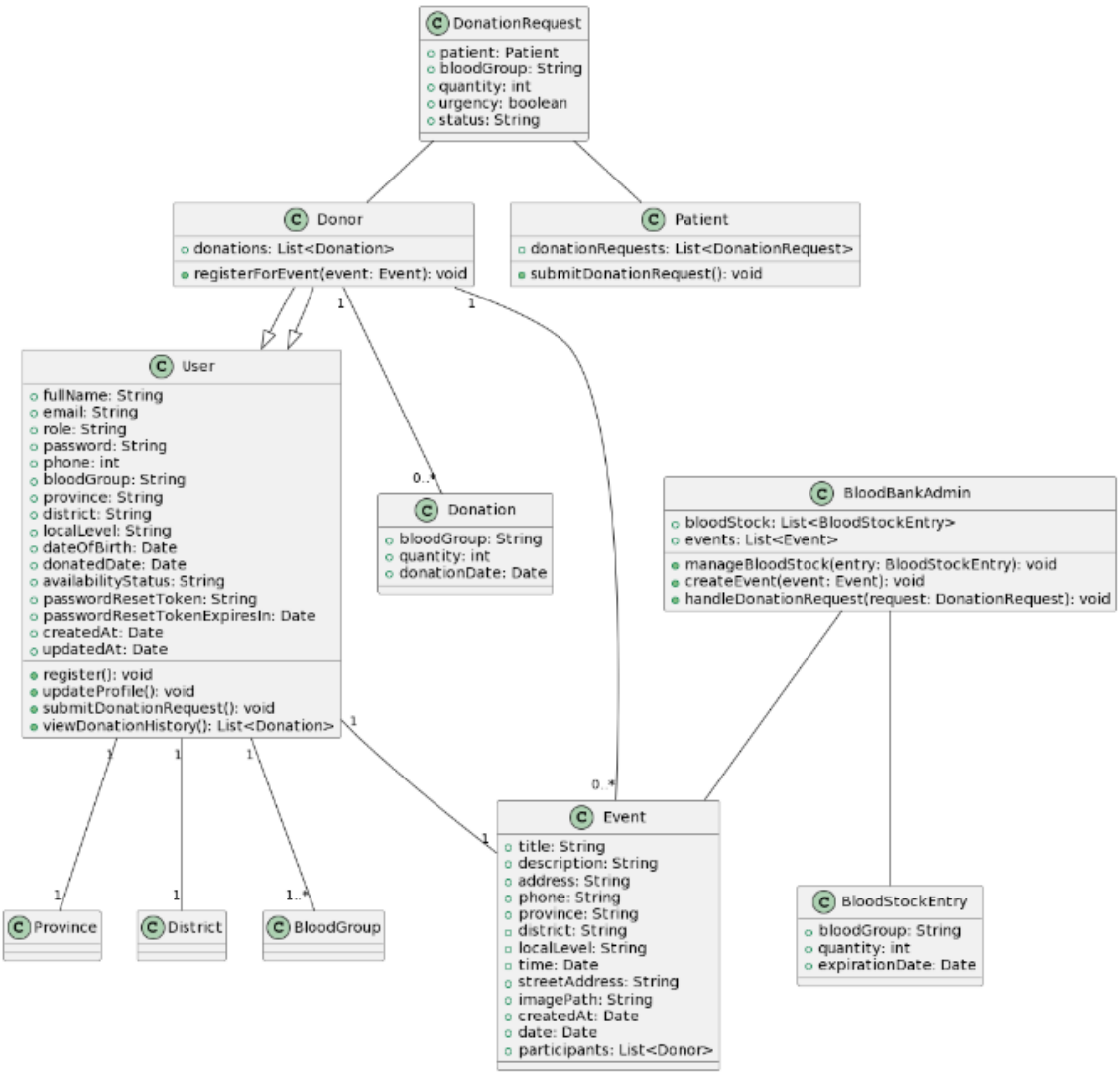

Figure 4.1: Refinement of class diagram

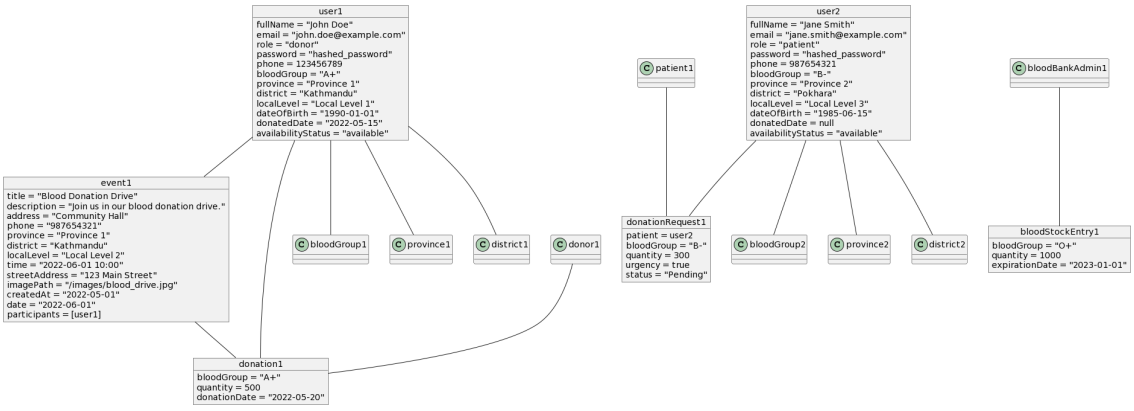

Figure 4.2: Refinement of object diagram

4.1.2 Component Diagram

The Component Diagram encapsulates the modular decomposition of the Blood Bank Management System into logical components or subsystems, such as User Interface, Database Manage-

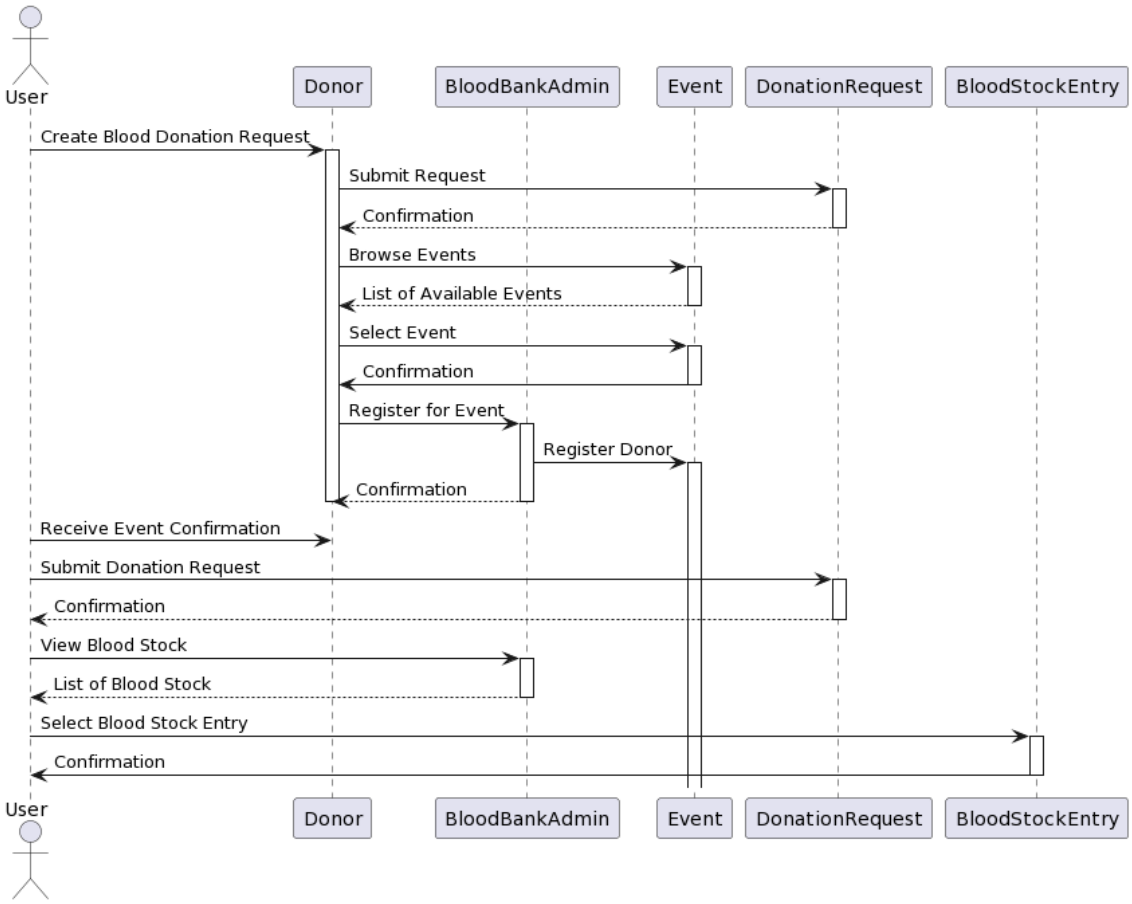

Figure 4.3: Refinement of sequence diagram

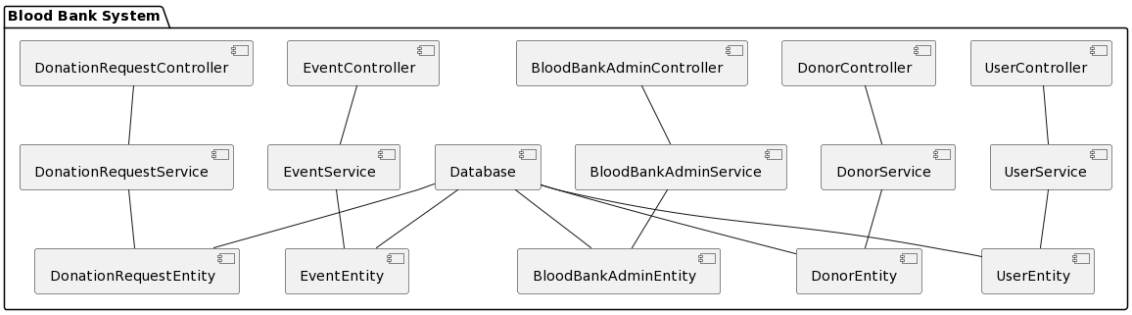

Figure 4.4: Component Diagram

ment, and Notification Service. It highlights the dependencies and interfaces between components, promoting maintainability and system organization.

4.1.3 Deployment Diagram

The Deployment Diagram depicts the physical arrangement and network configuration of hardware and software nodes involved in running the Blood Bank Management System. It details servers, clients, database servers, and their communication paths, providing clarity on deployment environments, scalability, and system robustness.

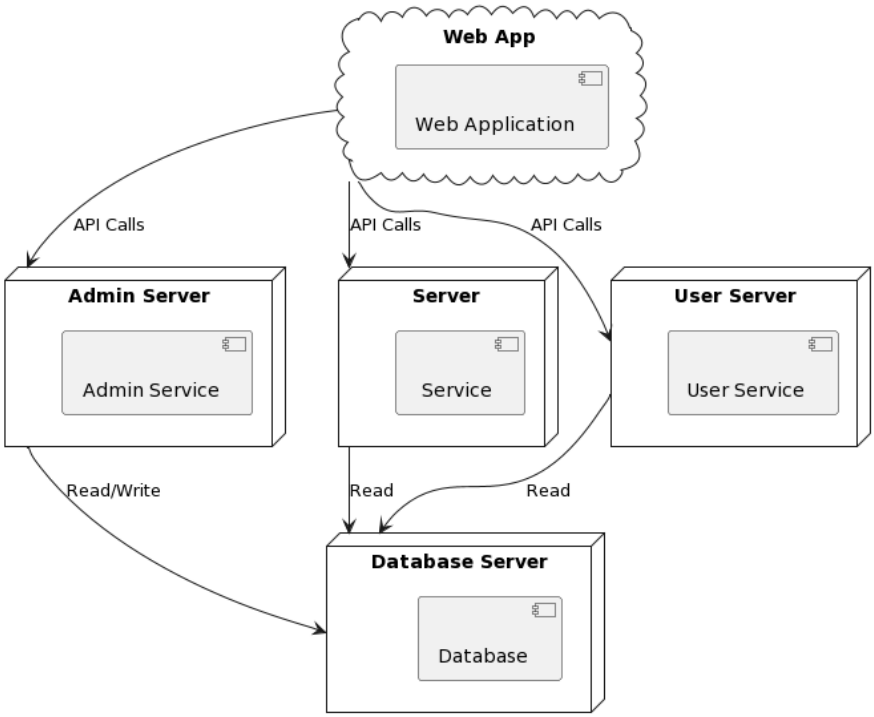

Figure 4.5: Deployment Diagram

4.2 Algorithm Details

4.2.1 1. Token Validation and Authentication Algorithm

This system implements JSON Web Token (JWT) [28] for authentication, ensuring secure login and session handling. The working steps are:

(a) Token Creation during Login

- User provides login credentials (email & password).
- The system verifies the credentials against the database.
- If valid:
  - A JWT token is created using the users unique `id`.
  - The token is signed with a secret key (`process.env.JWT_SECRET`).
  - The token is stored in a secure HTTP-only cookie (`jwtToken`) and sent to the client.
- If invalid:
  - An error message is displayed (`Invalid email or password`).

(b) Token Validation

- When accessing a protected route, the system checks for a valid token in the cookie.
- If the token is present and valid: User access is granted.
- If the token is missing or expired: Redirect to the login form with an error message.

(c) Logout Action

- On logout, the system clears the `jwtToken` cookie.
- Session is terminated, and the user is redirected to the homepage.

4.2.2 2. Password Hashing Algorithm (bcrypt)

The system uses the **bcrypt** cryptographic hashing algorithm [29] for securely storing user passwords in the database.

(a) Registration (Storing Passwords)

- User enters a plain password (e.g., `mypassword123`).
- The system hashes the password using: *bcrypt.hashSync(password, 10)*
- The value `10` represents the cost factor (workload).
- A unique salt is generated and combined with the password.
- The final hash is a fixed-length string (cannot be reversed).
- This hashed password is stored in the database instead of the plain text password.

(b) Login (Password Verification)

- User provides their password at login.
- The system retrieves the stored hash from the database.
- Verification is performed using: *bcrypt.compare(password, storedHash)*
- bcrypt extracts the salt from the stored hash.
- Hashes the entered password with the same salt.
- Compares both results.
- If both match $\rightarrow$ Login successful.
- If not $\rightarrow$ Login fails with an error message.

4.2.3 3. Content-Based Filtering Algorithm

The system applies a **content-based filtering approach** [30] to recommend blood donors and donation centers.

Steps:

1. Extract attributes of donors (e.g., blood group, location, availability).
2. Extract attributes of storage centers/blood banks (e.g., address, province, contact info).
3. Match donors with recipients or nearby blood banks using keyword similarity and attribute matching.
4. Suggest donors/centers that are most relevant to the users query.

This ensures users find the most suitable donor or storage location based on their needs and geographic proximity.

4.2.4 4. Real-Time Tracking Algorithm

The system manages blood donation events and donor scheduling using a **real-time tracking mechanism** [31].

Steps:

1. Track scheduled blood donation events in the database.
2. Monitor donor availability status and update it dynamically.
3. Use periodic jobs (cron/scheduler) to refresh event details and donor eligibility.
4. Optimize allocation of resources (e.g., donor assignments, event capacity).
5. Provide administrators with up-to-date reports of donation activities.

This algorithm ensures efficient event scheduling and real-time coordination between donors, recipients, and hospitals.

CHAPTER 5: IMPLEMENTATION AND TESTING

5.1 Implementation

In this phase, logical designs and concepts developed during system analysis and design are converted into actual physical design. Tools, technology and environments used during implementation given below:

5.1.1 Tools Used

A general web based system requires different web specific technology in order to operate as expected. Blood Bank Web Based Management System is a combination of multiple modern days dynamic technical components. It consist of basic HTML to the complex database queries. Using the Express.js framework and JavaScript, this project was created as a full-stack application on the Node.js runtime environment. By allowing using of a single JavaScript codebase, the client-side front-end and server-side back-end could be built in the same language. Common server-side web development tasks like authentication, routing, and caching have been simplified easier with the Express.js framework. Because the back-end provides the static front-end files as well, the entire program can operate on the same port and server. Some of the additional tools and software used for this project are listed below with its short description

i. Draw.io [32]: This is a graph drawing software used for drawing various diagram required for software development process. We have used this for designing our diagrams etc.

ii. VS Code [33]: Visual Studio Code is a programming IDE that is easy to use and supports different extension for easy writing of source code.

iii. Over Leaf [34]: A collaborative, cloud-based online editor that simplifies the use of LaTeX for creating, editing, and publishing documents.

iv. XAMPP [35]: XAMPP is a free and open-source software package that provides an easy way to set up a local web server for development.

v. Mysql [36]: It is a database language supported by XAMPP that is used to query data in and from the database.

5.1.2 Implementation Details of Modules

The Blood Bank Management System is built using several main parts: the Admin Module, Hospital Module, and User Module. These parts are created using HTML, CSS, and EJS for the front-end and Node.js and MySQL for the back-end.

i. **Admin Module**
   The Admin Module is the main part for managing the system. It includes these features:

- **User administration:** This allows adding, changing, or deleting user accounts. Each account has a role, like patient, donor, blood bank, or admin.
- **Managing blood groups and events:** Admins can create, update, or delete blood group types and manage blood donation events.
- **Comprehensive dashboard:** This shows important information and data for monitoring the system.
- **System configuration:** Admins can set settings like notification limits and language choices.

ii. **Hospital Module**

The Hospital Module is mainly for managing blood stock. Its key functions are:

- **Blood Stock Management:** Hospitals can add, change, or remove blood stock records. These records include blood type, quantity, and expiration date.
- **Donation request handling:** The system matches donation requests with available blood.
- **Dashboard and reports:** This shows real-time updates and lets users make reports on blood usage, donation trends, and event participation.

iii. **User Module**

The User Module is for people who sign up as donors or patients. Its features are:

- **Submitting blood donation requests:** Users can ask for blood donations. Profile management: Users can edit their personal info, see their donation history, and update their availability.
- **Notification system:** Users get updates about events, donation requests, and other important news.

iv. **Algorithms Used**

The project uses certain algorithms to improve its performance:

- **Content-based filtering:** This helps suggest things based on user interests. In the blood bank system, it helps find donor or store locations that match user criteria.
- **Real-time tracking:** This helps organize blood donation events and manage resources efficiently, making sure everything runs smoothly with donors' schedules.

5.2 Testing

Software Testing is a method to check whether the actual software product matches expected requirements and to ensure that software product has minimal defect. It involves execution of system components using manual or automated tools to evaluate one or more properties of interest.

5.2.1 Test Cases for Unit Testing

Table 5.1: Unit Testing

SN	Test Case	Test Data	Expected Output	Result
1	Register new donor	User details: Name, Email, Blood Type	Success message and new donor added to the database	Success
2	Submit blood donation request	Request details: Blood Type, Quantity, Urgency	Success message and request recorded in the system	Success
3	Add new blood group	Blood group details: Name	Success message and new blood group added	Success
4	Create a blood donation event	Event details: Title, Date, Time, Location	Success message and event added to the system	Success
5	Update user profile information	New user details: Updated Name, Email, Blood Type	Success message and user details updated	Success
6	Manage blood stock - Add new entry	Stock details: Blood Type, Quantity, Expiration Date	Success message and new stock entry added	Success
7	Handle blood donation request as a hospital	Donor details: Name, Blood Type, Donation Status	Success message and request marked as handled	Success
8	View upcoming blood donation events	-	List of upcoming events displayed	Success
9	Retrieve user donation history	-	List of past donations for the user displayed	Success

5.2.2 Test Cases for System Testing

Table 5.2: System Testing

SN	Test Case	Test Data	Expected Output	Result
1	User Registration and Login	New user registration details	Successful login after registration	Success
2	Blood Donation Request Workflow	User submits a donation request	Notification to hospitals ,successful matching	Success
3	Event Creation and Participation	Admin creates a blood donation event	User resisters for the event	Success
4	Blood Stock Management	Hospitals add and manage blood stock	Successful addition and management of blood stock	Success
5	User Profile Management	User updates profile information	Successful update of user details	Success
6	Admin Dashboard and Analytics	Admin views system analytics and metrics	Accurate analytics and metrics displayed	Success
7	Notification System	User receives automated notification	Timely and relevant notifications	Success
8	Blood Donation Event Coordination	Hospitals coordinate and manage donation events	Smooth coordination and successful event	Success
9	Report Generation	Admin generates reports on blood usage and trends	Comprehensive and accurate reports generated	Success
10	System Security and Access Control	Unauthorized access attempt	Restricted access and appropriate security measures	Success

5.3 Result Analysis

From the beginning of the Blood Bank Management System project until it was developed, implemented, and improved, a lot of research and analysis was done, contain looking at previous studies. Even though we faced some difficulties during the development phase, we managed to conquer them by making necessary changes and conducting more research. We used various resources and learned important things like understanding new terms and developing good habits for entering data. In the end, we were happy with the result because the system worked exactly as we had planned, helping to automate and simplify the process of getting blood during an emergency.

The network promising rotate ideas and rational designs into a real working application. It was built using HTML, CSS, and EJS for the front-end, and Node.js with MySQL for the back-end. Since it is a web-based tool, it can be accessed online, making it easy for users to find and view available blood resources. Using this app, we can manage all the necessary records across its different modules:

- The **Admin module** acts as the power regulate hub for the system. It allows managing users (adding, changing, removing), handling blood groups, organizing events, and providing a detailed dashboard with important data and insights.
- The **Hospital module** helps manage blood stocks, let hospitals add, edit, or remove blood stock records, process donation requests by matching them with available stocks, and organize blood donation events.
- The **User module** is for individuals, enabling them to sign up as donors or patients, request blood donations, sign up for events, and update their profiles, all supported by a notification system.

Comprehensive Unit Testing and System Testing proved that the system was successfully built and works well. All test cases passed with a "Success" result. For example: Unit tests confirmed that features like registering new donors, submitting donation requests, adding blood groups, creating donation events, updating user profiles, managing blood stock, handling requests from hospitals, viewing events, checking donation history, and deleting blood groups all worked as intended. System tests showed that important workflows like user registration and login, the full process of requesting blood donations, event creation and participation, blood stock management, user profile handling, accurate dashboard analytics, on-time notifications, smooth event coordination, detailed report generation, and secure access control were all successfully executed. The project provides a thorough platform where users can access information, moving from old handbook approach to an online system. All data and records are safely stored in a database. It brings together recipients, donors, and blood banks, connecting them more effectively. This system makes it easier to get blood when needed, allowing passive to find the blood they require quickly. This improves access to medical and emergency blood needs and reduces delays in healthcare responses. The system has been appropriately examined and works well, helping to speed up the delivery of blood to those in need. This plays a key role in saving lives and reducing panic during emergencies.

CHAPTER 6: CONCLUSION AND FUTURE RECOMMENDATIONS

6.1 Conclusion

The proposed Blood Bank and Donor Management system is developed and is used to reduce the time required to deliver required blood to the needy in cases of emergency. The project aims to act as an important role in saving life of huma beings and reduce the panic created in emergency situations. Overall, the main idea of the management of blood and donor work is for solving problems related to the blood banks from collecting blood from donators to distributing blood bags for interested patients. Patients from different corner of the area can rely on this specified website which helps to search for required/needed blood in case of emergency. Users can also be provided with proper information regarding donors and avail blood in the centre. So, Blood bank management system helps in providing major information regarding availability of blood and requested donors details. Hence, Blood bank management system helps in providing major information regarding availability of blood and requested donors details.

6.2 Future Recommendations

To enhance the overall functionality and effectiveness of the Blood Bank Management System, several key recommendations have been identified. Firstly, it is advised to improve the user interface to optimize user experience and ensure responsiveness across various devices. Enhancing error handling mechanisms, including user-friendly error messages and robust logging, will contribute to a more resilient system. Performance optimization through database query refinement and efficient data retrieval processes is essential to maintain optimal system responsiveness. Strengthening security measures, such as following secure coding practices, regular software updates, and comprehensive security audits, will safeguard sensitive data and protect against potential threats. Additionally, planning for scalability and conducting load testing will ensure that the system can handle increased demand effectively. User education and training initiatives, including accessible materials and training sessions, will foster user familiarity with the system's features. Establishing regular backup procedures, developing a disaster recovery plan, and ensuring compliance with data protection regulations contribute to data integrity and regulatory adherence. Furthermore, a feedback mechanism should be implemented to gather user input, aiding in the identification of areas for improvement. Continuous monitoring through monitoring tools will proactively address any emerging issues, contributing to ongoing system stability and reliability. These recommendations collectively aim to fortify the Blood Bank Management System, ensuring it remains robust, secure, and user-friendly. Regular evaluations and updates based on user feedback and technological advancements will contribute to the system's sustained success.

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APPENDIX

7.1 Screenshots of Supervisor Visit Schedule

Date	Time	Purpose of Visit	Discussion / Notes
2025-05-15	11:00 AM	Project proposal discussion	Discussed scope and objectives of the UrbanFix project. Supervisor suggested including analytics and leaderboard features.
2025-06-05	1:30 PM	UI and functionality review	Reviewed My Reports page and notifications implementation. Supervisor approved current design; suggested minor improvements in map visualization.
2025-06-27	11:00 AM	Backend logic discussion	Discussed analytics data aggregation and leaderboard calculation. Supervisor advised implementing resolution rate and category-wise statistics.
2025-07-24	11:00 AM	Testing and validation	Demonstrated in-app notifications, analytics graphs, and leaderboard. Supervisor provided feedback on edge cases and recommended adding unit tests.
2025-09-23	1:30 PM	Final review	Reviewed full project functionality including maps, analytics, notifications, and leaderboard. Supervisor approved for report submission.

Figure 7.1: Screenshot of Supervisor Visit Schedule

7.2 Screenshots of Major Source Code Components

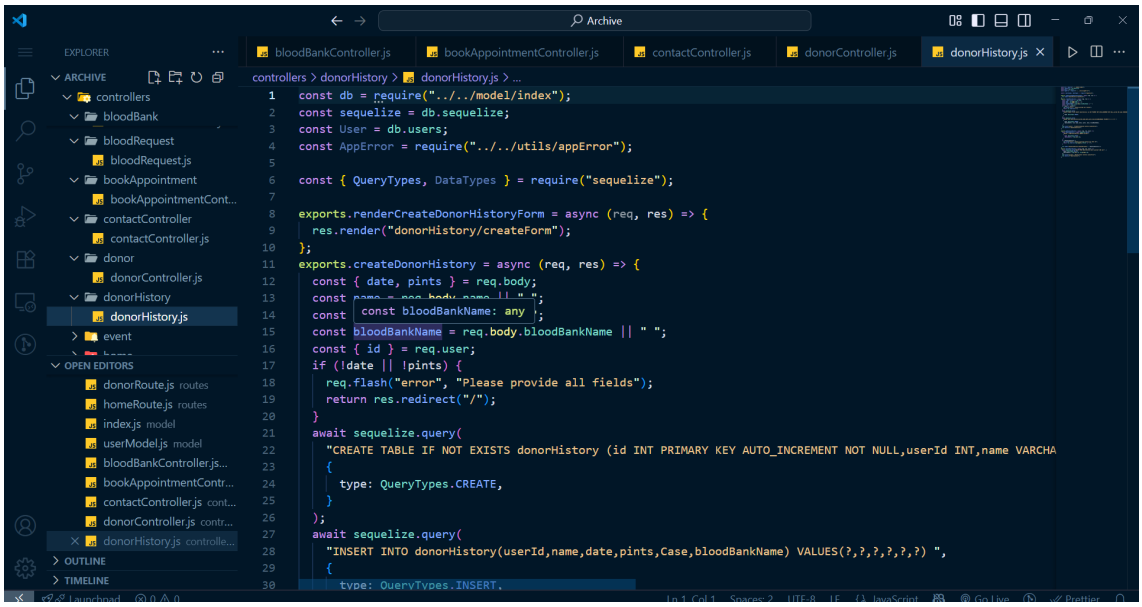

Figure 7.2: Screenshot of donorHistory.js

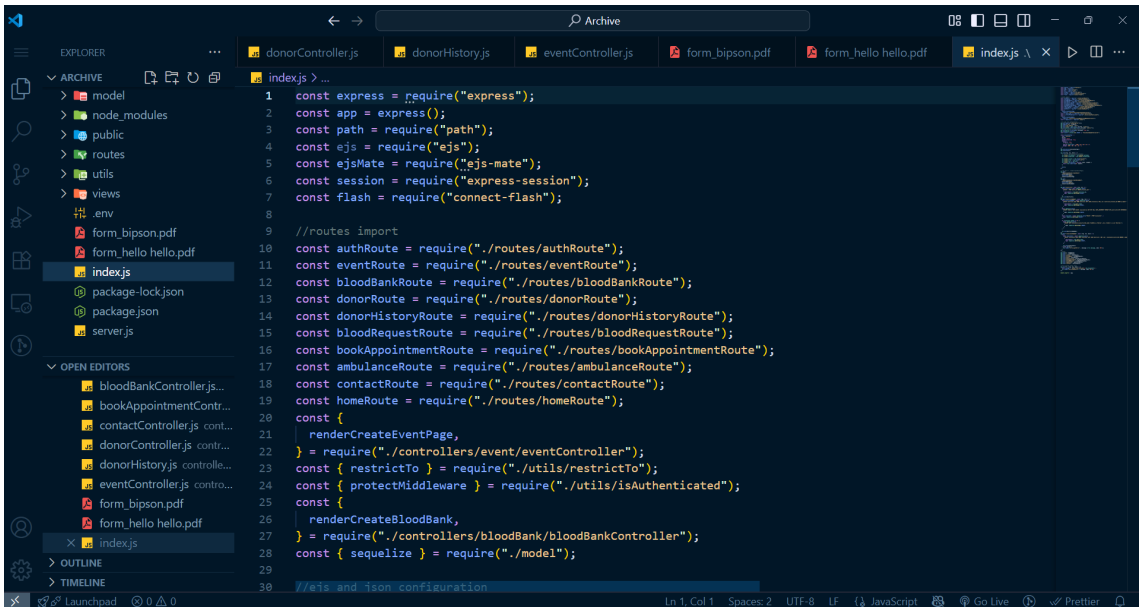

Figure 7.3: Screenshot of index.js

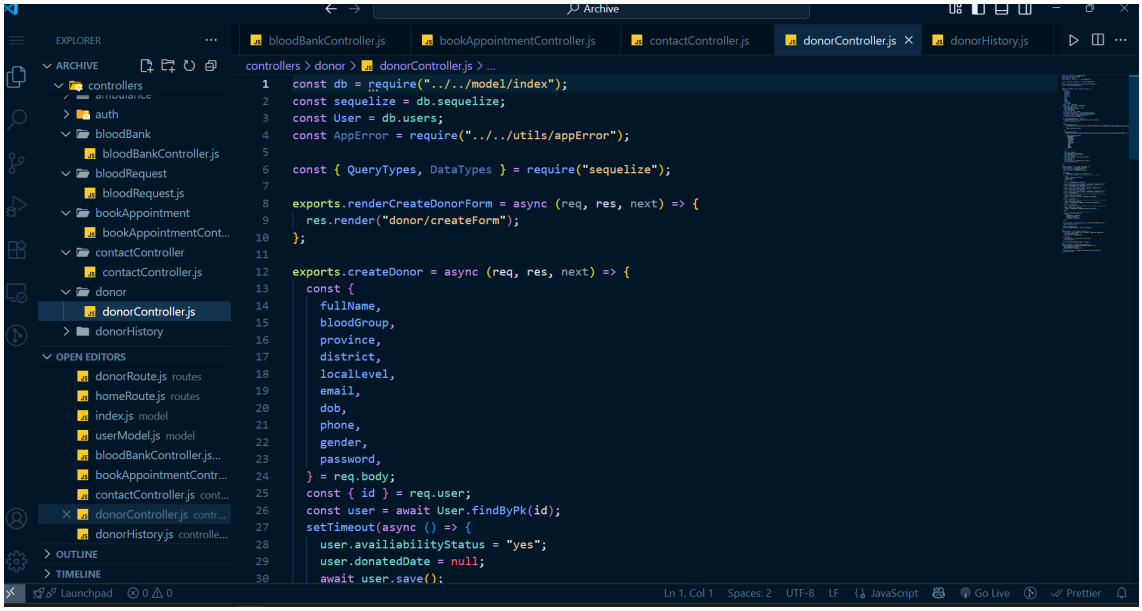

Figure 7.4: Screenshot of donorController.js

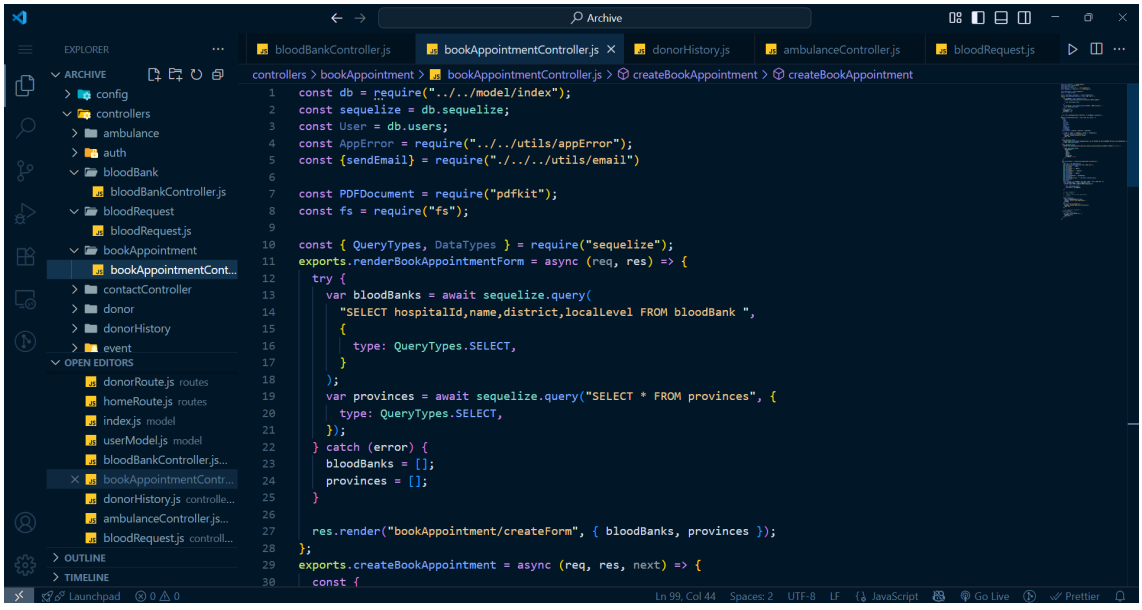

Figure 7.5: Screenshot of bookAppointmentController.js

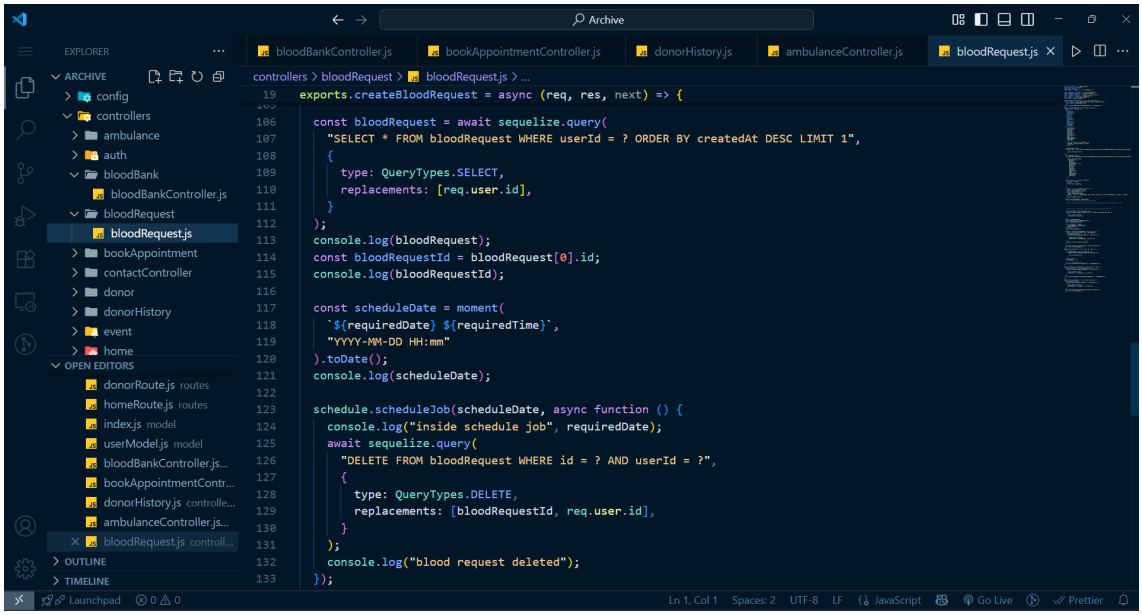

Figure 7.6: Screenshot of bloodRequest.js

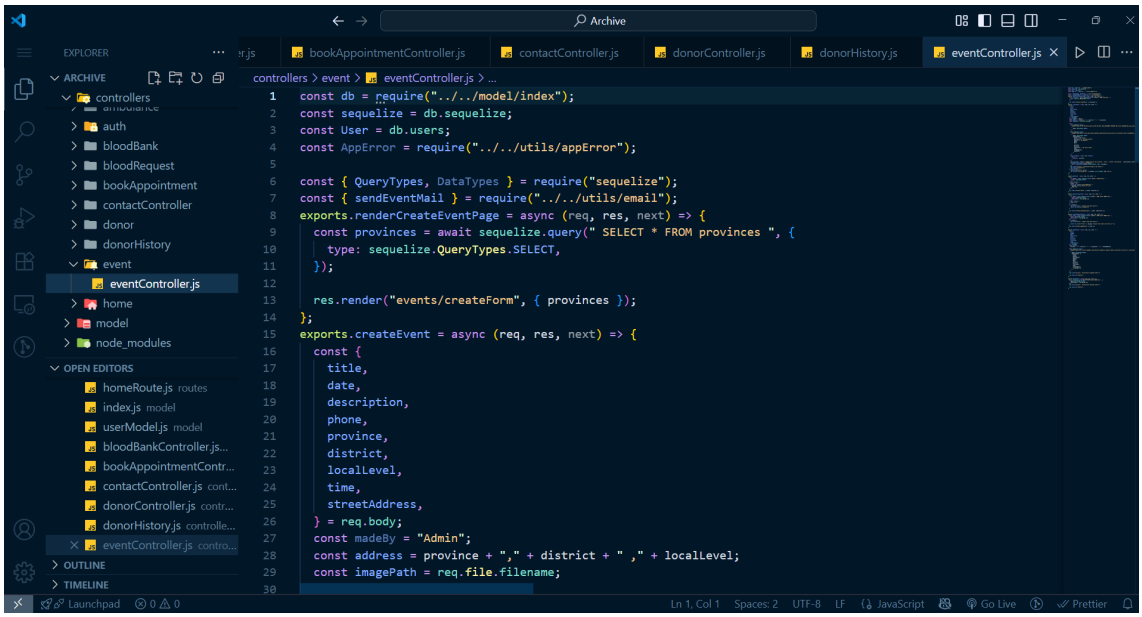

Figure 7.7: Screenshot of eventController.js

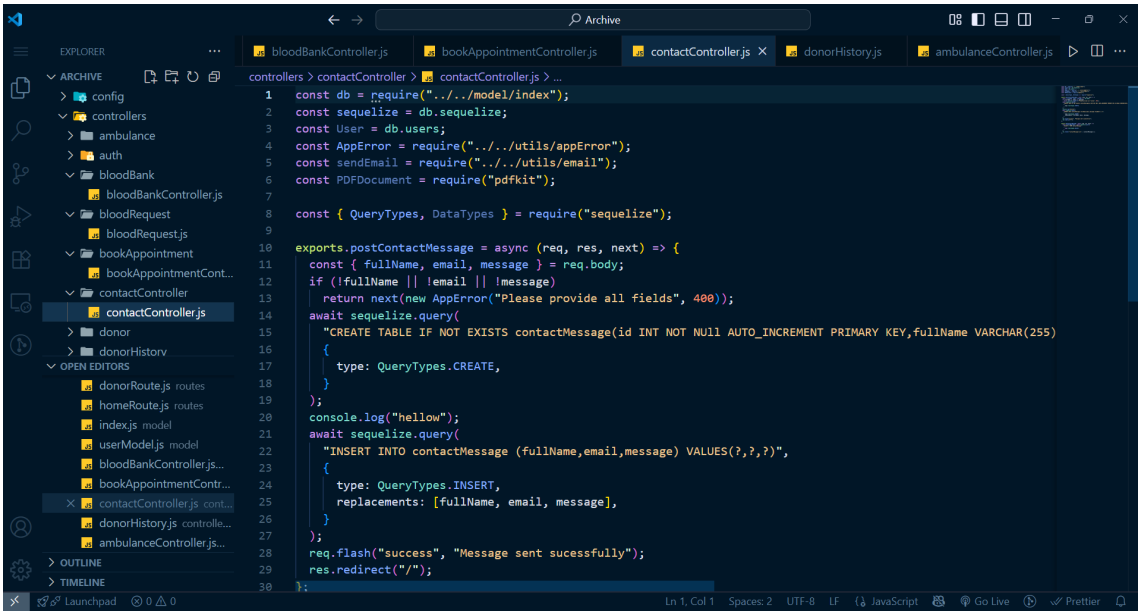

Figure 7.8: Screenshot of contactController.js

7.3 Screenshots of User Interface

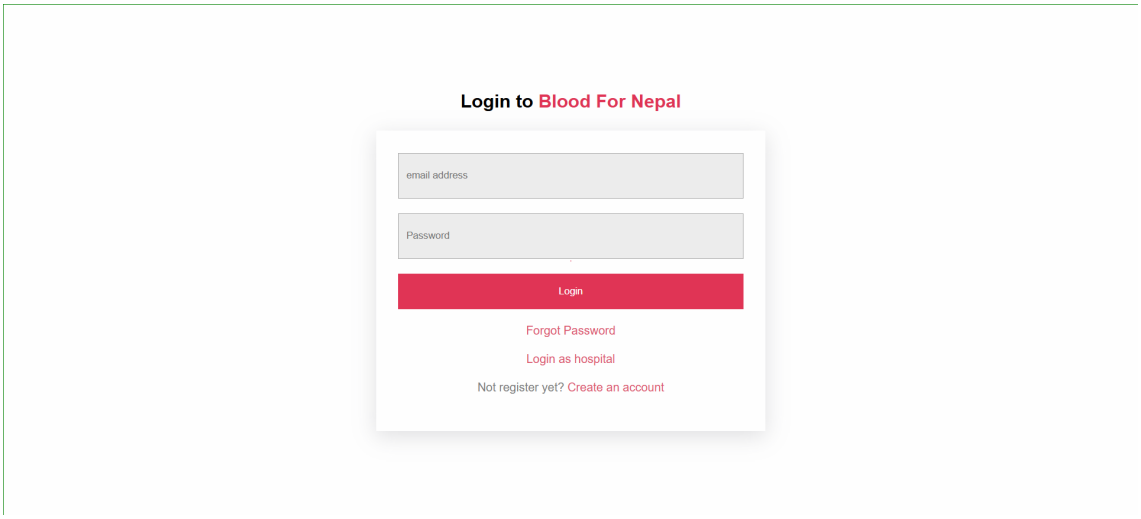

Figure 7.9: Screenshot of Login Page

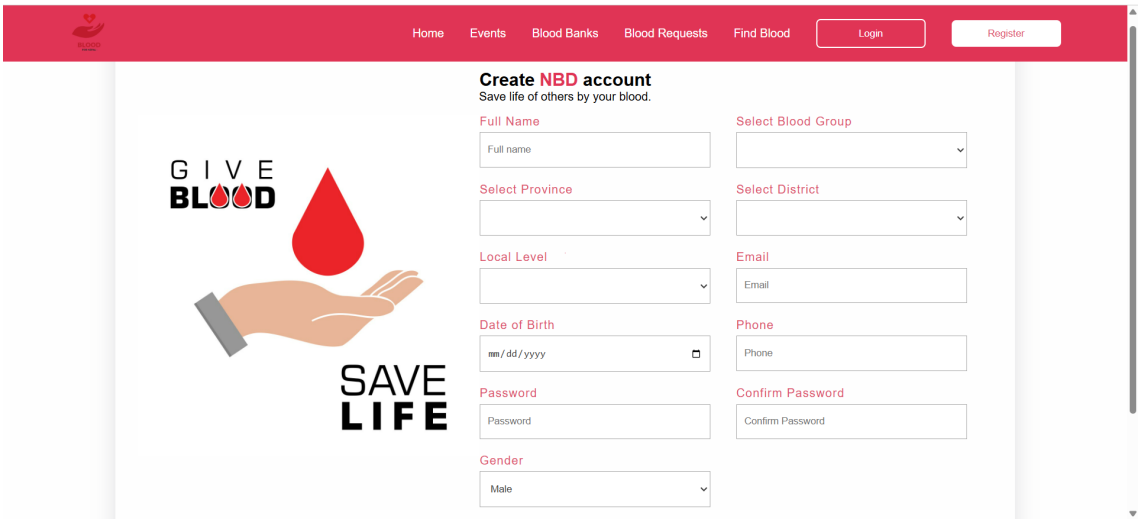

Figure 7.10: Screenshot of Registration Page

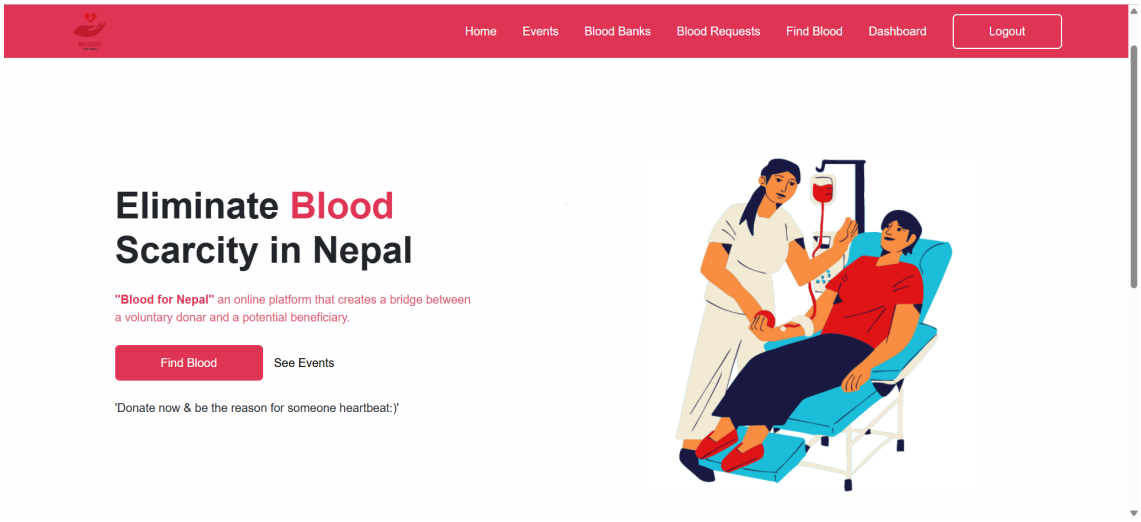

Figure 7.11: Screenshot of Home Page

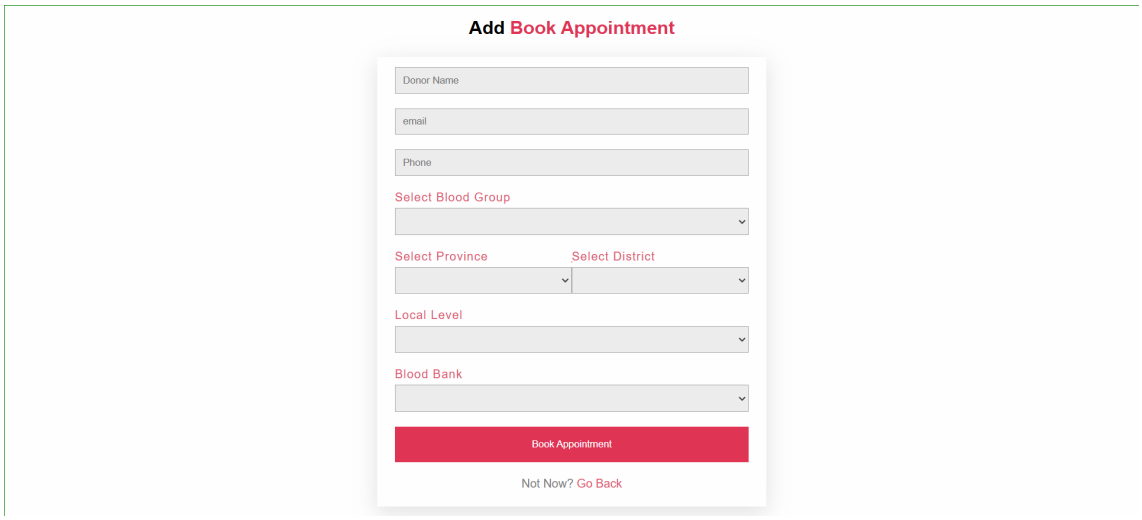

Figure 7.12: Screenshot of Booking appointment Page