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Research Paper

# Intelligent Web-Based Blood Bank and Donor Management System Using Django Framework

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## ABSTRACT

Blood plays an essential role in emergency healthcare, disaster response, and surgical procedures. The demand for safe, timely, and readily available blood units continues to grow, whereas traditional blood bank operations still rely heavily on manual record keeping, phone-based communication, and inefficient donor tracking. These limitations often lead to delays, data inconsistency, shortage mismanagement, and the inability to quickly reach suitable donors during critical medical situations. To address these challenges, this project proposes an Intelligent Web-Based Blood Bank and Donor Management System developed using the Django web framework. The system streamlines the management of donors, blood banks, inventory, donation approvals, and blood request workflows through a centralized, automated platform.

The proposed system integrates multiple user roles, including administrators and donors, each equipped with dedicated dashboards and role-based access control. Donors can register, maintain detailed donor profiles, track donation history, and submit blood requests. Administrators can manage blood banks, update blood inventory, approve or reject donations, monitor donor availability, and oversee pending blood requests. Automated email notifications help improve system communication by instantly informing donors and administrators about approvals, rejections, and request updates. Additionally, the admin dashboard provides statistical summaries such as total donors, available donors, total blood banks, inventory by blood group, and recent request/donation activities. These real-time insights improve decision-making related to stock replenishment, donor outreach, and emergency readiness.

A major strength of the system lies in its structured management of blood inventory. Blood units are categorized by blood group and quantity, allowing administrators to maintain transparent records and ensure that hospitals or patients receive accurate information

about availability. The system also enhances donor engagement by enabling donors to check their previous donations, availability status, and eligibility based on donation history. The secure authentication and authorization mechanisms ensure that sensitive health-related information is handled safely.

Overall, the proposed Blood Bank and Donor Management System reduces manual workload, enhances accuracy, minimizes response time, and improves coordination between donors, administrators, and healthcare providers. By offering a reliable digital alternative to traditional management systems, this platform contributes towards strengthening healthcare infrastructure and making life-saving blood services more accessible. The project demonstrates the practical application of modern web technologies for solving real-world healthcare management challenges and provides a scalable foundation for future enhancements such as mobile integration, real-time donor geolocation, AI-based donor matching, and automated emergency donor alerts.

**Keywords:** Blood Donation, Blood Bank Management, Django, Donor Profile, Inventory Management, Blood Requests, Automation, Healthcare Information System

## I. INTRODUCTION

Blood donation is a critical component of modern healthcare systems, enabling hospitals to perform emergency surgeries, treat trauma cases, conduct transfusions, and support patients suffering from life-threatening conditions such as anemia, cancer, and hemophilia. Despite its importance, many regions still struggle to maintain adequate blood supplies due to inefficient management processes, outdated record systems, communication delays, and lack of efficient donor coordination. Traditional blood banks often rely on fragmented systems for maintaining donor information, monitoring blood inventory, or processing blood requests. This fragmentation limits their ability to respond quickly during emergencies, ultimately risking patient safety.

The introduction of digital healthcare management solutions provides an opportunity to modernize these operations. With advancements in web development technologies, it is now possible to create real-time, automated systems that reduce manual workload, improve accuracy, and enhance communication among stakeholders. This project presents an Intelligent Web-Based Blood Bank and Donor Management System built using the Django framework, a robust and scalable backend technology commonly used for developing secure and high-performance applications.

The system is designed to provide seamless interaction between donors and administrators. Donors are able to register, authenticate, complete donor profiles, update availability, view donation history, and submit new blood requests. Administrators, on the other hand, have complete authority over managing blood banks, maintaining inventory records, reviewing donation submissions, and approving or rejecting blood requests. The integration of email

notifications helps automate communication and ensures that users remain informed at all stages of the workflow.

A significant feature of the system is the dynamic Admin Dashboard, which aggregates essential data such as total donors, available donors, pending requests, and blood inventory statistics. This improves administrative decision-making and ensures that blood banks remain well-prepared for emergencies. The system also supports CRUD operations for blood banks and inventory, allowing administrators to add, update, or remove entries as required.

By incorporating secure authentication, structured data models, and role-based access control, the system ensures that user information is protected. The platform's architecture emphasizes flexibility, scalability, and maintainability, allowing easy future expansion such as integration with mobile applications, donor geolocation, or hospital interfaces.

In summary, this project highlights the potential of digital transformation in the healthcare sector, particularly in the domain of blood management. The proposed system enhances transparency, accuracy, and accessibility—ultimately contributing to improved medical outcomes and saving more lives.

## **II. LITERATURE SURVEY (WITH EXISTING METHODS)**

The efficient management of blood donation and transfusion services has been the subject of numerous research studies, given its critical role in healthcare. Existing literature highlights recurring challenges such as blood shortages, outdated donor records, slow response times, and lack of integration between hospitals, donors, and blood banks. Research has explored various technological solutions to address these issues, including web-based platforms, mobile applications, information management systems, and intelligent decision-support systems.

Early blood bank management solutions predominantly used desktop-based applications. These systems, while useful, lacked real-time accessibility and could not handle large-scale, distributed data. Researchers found that such systems often suffered from data redundancy, poor scalability, and difficulty in synchronization across multiple centers. Furthermore, manual data entry and limited user access features reduced efficiency.

With advancements in internet technologies, web-based systems became a focus area. Studies demonstrated that web-based blood management systems improved accessibility and eliminated many problems associated with local storage. Authors proposed donor registration modules, inventory updating mechanisms, and SMS-based communication systems. However, many early web systems lacked secure authentication, role-based access, and automated communication features, limiting their practical adoption.

Recent research emphasizes integrating real-time donor tracking, automated notifications, and inventory monitoring. Systems using SMS and email alerts proved helpful in reducing delays. However, most existing implementations lacked structured dashboards, analytical

insights, and multi-role support, which are crucial for real-time decisions in emergency healthcare.

Some researchers explored AI-based donor matching, predicting blood demand, and optimizing inventory levels. Although these approaches introduced promising improvements, they often required substantial computational resources and large datasets, making them suitable for advanced systems but impractical for mid-scale blood banks.

Compared to existing methods, the proposed Django-based solution distinguishes itself by offering:

- Role-based user authentication (donor/admin)
- Complete donor profile management
- Real-time blood inventory tracking
- Donation approval and request management workflows
- Admin dashboard with analytics
- Automated email notifications
- Centralized and secure database architecture

This system addresses the shortcomings in earlier models by integrating automation, secure user roles, real-time insights, and streamlined workflows—leading to faster decision-making and improved service responsiveness. Thus, the proposed model aligns with modern healthcare information system requirements and improves upon traditional systems by delivering an efficient, user-friendly, and scalable platform.

### III. EXISTING SYSTEM

Traditional blood bank management systems predominantly rely on manual procedures, paper records, and offline communication. These methods are highly prone to errors, data duplication, and inefficiencies. In many existing setups, donor information is stored in handwritten logs or basic spreadsheet formats, making it difficult to retrieve accurate data quickly, especially during emergencies. Blood inventory updates are often delayed, leading to misinformation about the availability of specific blood groups. This lack of real-time inventory tracking results in either shortages or wastage of blood units.

Another significant limitation is the absence of a centralized platform where donors and administrators can interact seamlessly. Donors typically need to contact blood banks through phone calls or physical visits, which slows down the process of blood donation, registration, or verification. Similarly, blood requests from patients or hospitals often

require manual review, and communication regarding approval or rejection is slow and inconsistent. Many existing systems do not support donor availability tracking, making it difficult to identify eligible donors during urgent medical situations.

Additionally, traditional systems lack automated features such as notifications, donor reminders, donation tracking, or analytics dashboards. Without such features, administrators struggle to maintain operational efficiency or make data-driven decisions. There is also minimal security in traditional systems, as sensitive donor information may be accessible to unauthorized personnel.

In summary, the existing systems suffer from poor coordination, lack of digitization, minimal security, and no real-time data access. These inefficiencies highlight the need for a modern, automated, and secure blood bank management system capable of improving overall healthcare delivery.

#### **IV. PROPOSED METHOD**

The proposed system is a fully digital, web-based Blood Bank and Donor Management System designed to eliminate the shortcomings of traditional manual processes. The system aims to automate donor management, blood inventory tracking, donation approvals, and blood request handling through a centralized and secure platform. It offers role-based access for both donors and administrators, ensuring that users can only perform actions that align with their responsibilities.

Donors can easily register, log in, and complete their donor profiles with essential information such as blood group, health history, and availability. They can also view their donation records, track their status, and submit blood requests when needed. The system ensures that donors receive timely updates through automated email notifications whenever their blood request is approved, rejected, or updated.

Administrators are equipped with powerful management tools through a dedicated dashboard. They can oversee blood bank operations, manage blood inventory, approve or reject donation submissions, and monitor all pending blood requests. The dashboard provides real-time statistics including total donors, available donors, active blood banks, pending requests, and grouped blood inventory levels. These analytical insights help administrators make informed decisions, especially in emergencies.

By integrating automation, secure authentication, and real-time communication, the proposed system increases efficiency, reduces delays, and improves the overall responsiveness of blood bank operations. It ensures accurate data handling, enhances transparency, and provides a reliable, scalable solution for improving blood availability and donor coordination in healthcare environments.

#### **V. IMPLEMENTATION**

The implementation of the Blood Bank and Donor Management System is carried out using the Django framework, which follows the Model-View-Template (MVT) architecture. This architecture ensures a clean separation of concerns, making the system more maintainable and scalable.

1. **User Authentication and Authorization** The system uses Django's built-in authentication mechanisms to manage user registration, login, and logout functionalities. Custom user models with a `user_type` field differentiate donors from administrators. Role-based redirection ensures that each user accesses an appropriate dashboard.

2. **Donor Management Module** Donor-related data is stored through the Donor Profile model. Donors can create and update their profiles, check donation history, availability status, and request blood as needed. The system validates donor information and stores records securely.

3. **Blood Bank and Inventory Management** Administrators can perform CRUD operations on blood banks using Django forms and model instances. Blood inventories are structured based on blood groups and quantity available. Inventory records are dynamically updated when new donations are approved or blood units are allocated.

4. **Blood Request Handling** Both donors and admins can create blood requests. Donors view their own requests, whereas administrators can view all requests. Admins approve or reject requests using dedicated forms and update the inventory accordingly. Automated email notifications inform requesters of any status updates.

5. **Donation Approval Workflow** DonationHistory records capture all donor contributions. Administrators review pending donations and approve or reject them. Approval updates donor eligibility attributes and inventory units.

6. **Admin Dashboard and Analytics** The admin dashboard displays statistical insights retrieved using Django ORM queries. The dashboard includes visual summaries such as recent donations, recent requests, donor distribution by blood group, and total blood inventory.

7. **Notifications System** The system uses Django's `send_mail` function to send email notifications for request updates, donation approvals, and administrative alerts.

8. **Front-End and Templates** HTML templates combined with Django template tags render interactive pages. Bootstrap CSS ensures responsiveness, while error/success messages use Django's messaging framework.

Overall, the implementation ensures a robust, secure, and user-friendly blood bank management system capable of supporting real-world healthcare operations.

## VI. ALGORITHMS

Although the system is mainly CRUD and workflow-based, it uses several algorithmic and logical procedures to ensure proper operation.

1. Donor Availability Tracking Algorithm This algorithm identifies whether a donor is eligible to donate based on last donation date and availability status.

Input: Last donation date, health status

Output: True/False availability

Logic: If the last donation was more than 90 days ago and the donor is marked available, they are eligible.

2. Blood Inventory Update Algorithm Whenever a donation is approved or a blood request is fulfilled, the inventory is updated.

Input: Blood group, units involved, action type (add/remove)

If action = "add":  $\text{inventory}[\text{blood\_group}] += \text{units}$

If action = "remove":  $\text{inventory}[\text{blood\_group}] -= \text{units}$

Ensures non-negative inventory levels.

3. Blood Request Status Algorithm Determines request state based on admin action.

Inputs: Request ID, action (approve/reject)

If approved: status = 'approved' and requester notified

If rejected: status = 'rejected' with reason

All changes logged with timestamps.

4. Dashboard Analytics Algorithm

Generates statistics from large datasets using ORM aggregation:

Total donors =  $\text{COUNT}(\text{donor\_profile})$

Available donors =  $\text{COUNT}(\text{where is\_available} = \text{True})$

Inventory =  $\text{SUM}(\text{units\_available grouped by blood\_group})$

Pending requests =  $\text{COUNT}(\text{status} = \text{pending})$

These algorithms ensure accuracy, consistency, and real-time responsiveness throughout the system.

## VII. SYSTEM DESIGN

The system design follows the Django MVT (Model-View-Template) architectural pattern, ensuring modularity, scalability, and separation of logic and presentation.

1. Architectural Overview Models represent database structures such as DonorProfile, BloodBank, BloodInventory, DonationHistory, and BloodRequest.

Views handle incoming HTTP requests and business logic. Templates contain HTML, CSS, and Django template tags for UI rendering.

## 2. System Modules

a. User Management Module Handles registration, login, logout, password validation, and role-based access control. The custom user model differentiates between donor and admin functionalities.

b. Donor Module Includes donor profile creation, editing, viewing donation history, setting availability, and requesting blood. Validations ensure eligibility and correct input formatting.

### c. Blood Bank Module

b. Admins manage blood bank records, including name, location, contact details, and active/inactive status.

### c. d. Inventory Management Module

Maintains real-time inventory updates for each blood group. The system monitors units and ensures accurate tracking.

Request Management Module Supports creating, viewing, updating, and deleting blood requests. Admins review all requests, and donors access only their own.

f. Donation Management Module Admin approves or rejects donation submissions. Approval automatically updates donor eligibility and inventory levels.

3. Data Flow Donor/Admin logs into system. User requests a functionality (e.g., update profile, create request).

View receives the request → interacts with Model.

Model stores/retrieves data → returns response.

Template displays the output to the user.

## 4. Database Design

Relational database with structured tables:

Users

DonorProfile

BloodBank  
BloodInventory  
DonationHistory  
BloodRequest

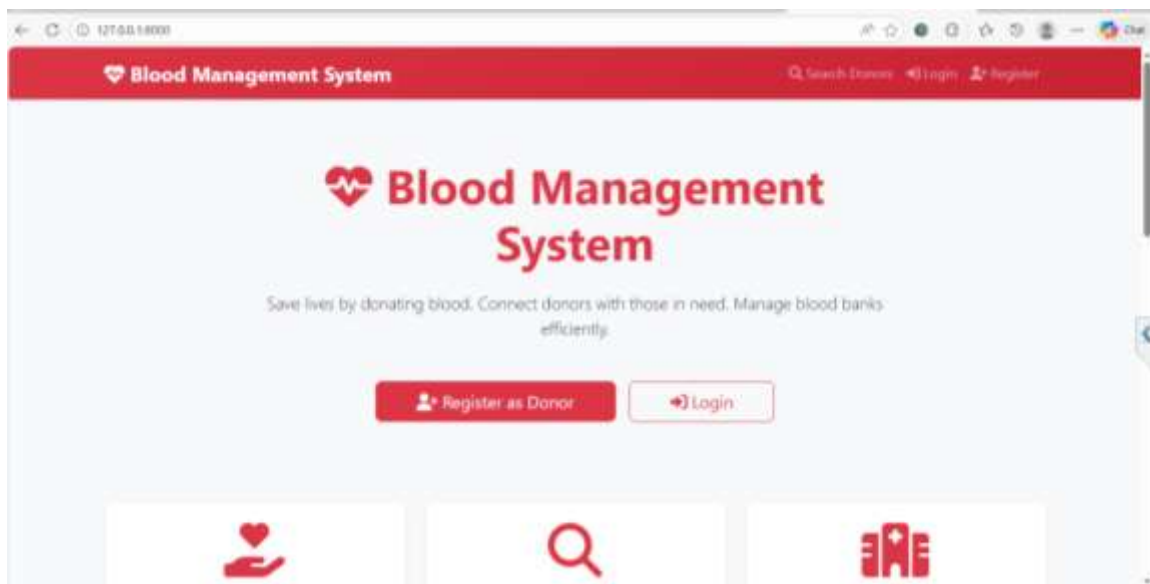
Foreign keys maintain relationships, ensuring consistency.

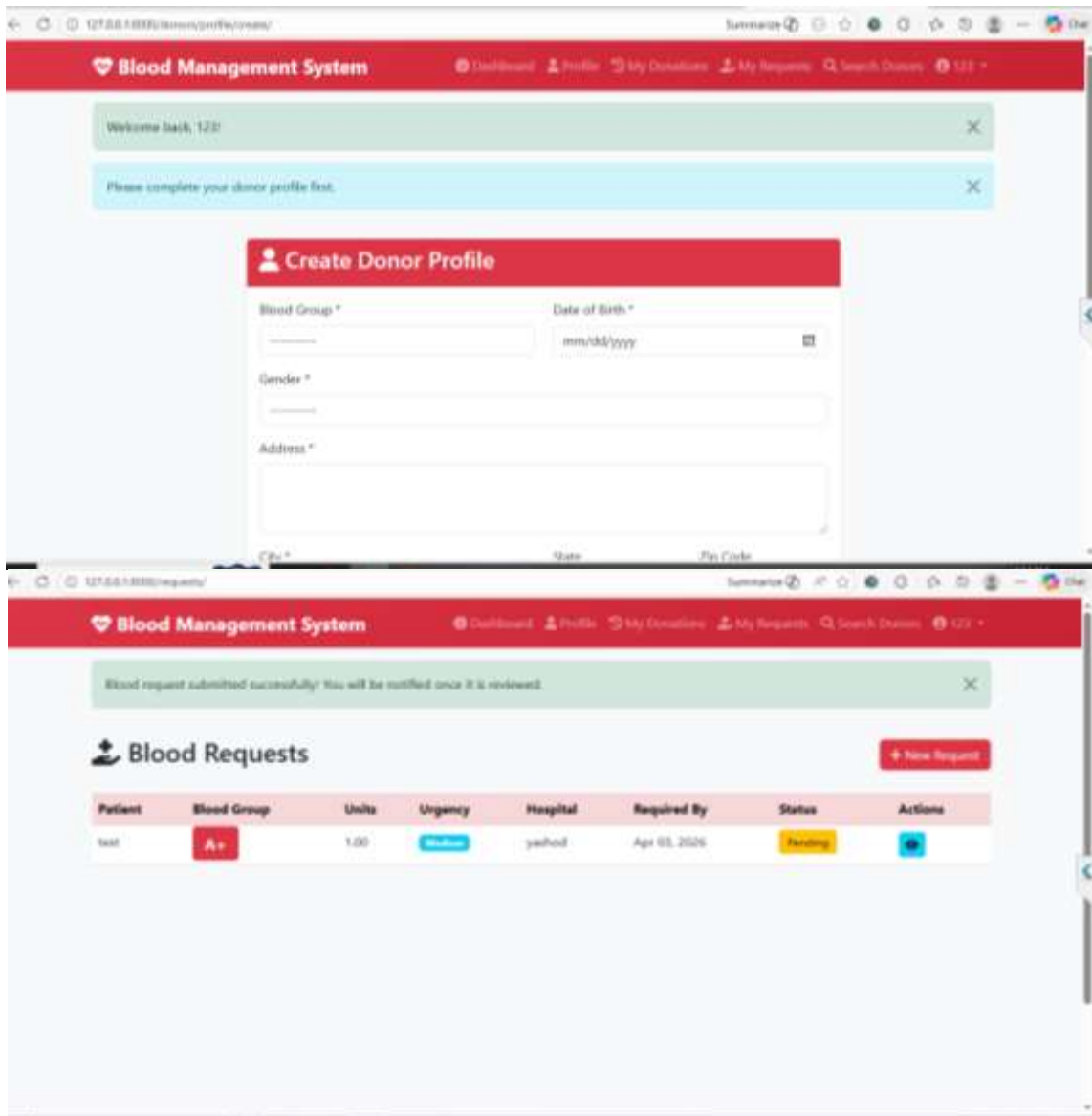
- 5. Security Design
  - Role-based authentication
  - Form validation
  - CSRF protection
  - Session management
  - Restricted admin-only operations
- 6. System Communication

Email notifications serve as asynchronous communication for approval or rejection of requests and donations.

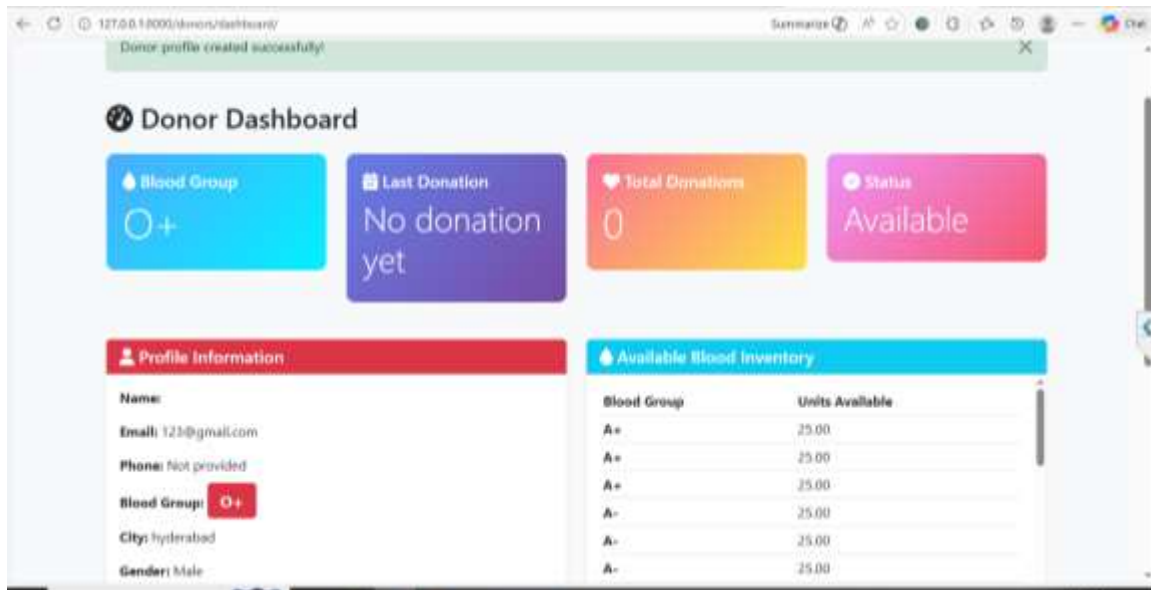
Overall, the system design ensures reliability, security, usability, and efficient data handling.

### SYSTEM DESIGN IMAGES





## VIII. CONCLUSION



The developed Blood Bank and Donor Management System successfully addresses the challenges present in traditional blood bank operations by digitizing and automating critical processes. Through its organized modules, real-time inventory tracking, seamless communication features, and role-based access control, the system significantly enhances the efficiency, speed, and accuracy of blood management activities. Donors benefit from an intuitive interface where they can update profiles, track donation history, and submit blood requests. Administrators enjoy a powerful dashboard with all essential tools for managing donors, donations, blood banks, and requests.

By replacing manual processes with automated workflows, the system reduces human error, ensures reliable data storage, and supports faster decision-making during emergencies. The integration of Django's secure authentication framework safeguards user information, while automated email notifications improve communication and keep stakeholders informed. The analytical insights provided through the dashboard enable administrators to maintain adequate stock levels and plan donor outreach activities more effectively.

Overall, the system contributes to strengthening healthcare services by ensuring timely availability of blood units and improving donor engagement. It also provides a scalable foundation for future enhancements such as hospital integration, AI-based donor matching, mobile application support, and location-based emergency donor alerts. This project demonstrates the practical use of web technologies in solving real-world healthcare management challenges and serves as a robust platform for expanding digital health infrastructure.

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