

ONLINE BLOOD BANK MANAGEMENT SYSTEM

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Abstract:

The effective management of blood donation services is essential for ensuring that healthcare organizations can provide timely blood transfusions during emergencies and routine medical treatments. Traditional blood bank management methods, which often depend on manual documentation or disconnected software systems, are associated with problems such as delayed processing, inaccurate inventory records, and inefficient communication among stakeholders. To overcome these challenges, this research proposes a web-based Online Blood Donation Management System developed using the Django framework with a centralized database for efficient information management. The application integrates key blood bank functions, including donor registration, patient blood request management, blood stock monitoring, and administrative control, within a unified digital platform. Blood inventory is updated automatically whenever a donation is approved or blood is issued, ensuring that stock information remains accurate and available in real time. The implementation of role-based authentication provides secure access by assigning specific permissions to administrators, donors, and patients according to their responsibilities, thereby improving both data security and system reliability. To further enhance user interaction, the system incorporates an Artificial Intelligence (AI)-enabled chatbot developed using Retrieval-Augmented Generation (RAG) and a Large Language Model (LLM). The chatbot retrieves relevant information from the system database and delivers context-aware responses to user questions related to blood donation eligibility, blood group compatibility, blood availability, donation procedures, and request status. This intelligent support mechanism reduces the workload of blood bank staff while providing users with immediate and accurate assistance. Performance evaluation indicates that the proposed system offers significant improvements in operational efficiency, data accuracy, inventory management, transparency, and response time when compared with conventional blood bank management practices. The modular architecture of the application also supports future enhancements, including cloud deployment, integration with hospital information systems, mobile application development, and multi-branch blood bank management. The proposed solution therefore provides a secure, scalable, and intelligent platform for modern blood donation management and contributes to improving the quality of healthcare services.

Keywords: Online Blood Donation Management System, Django Framework, Blood Inventory Management, Healthcare Information System, Artificial Intelligence (AI), Retrieval-Augmented Generation (RAG), Large Language Model (LLM), Web-Based Application, Role-Based Access Control (RBAC).

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Introduction:

The availability of safe and sufficient blood is one of the fundamental requirements of modern healthcare. Blood transfusions are essential for treating accident victims, surgical patients, individuals undergoing cancer treatment, organ transplant recipients, mothers during childbirth, and many other

critically ill patients. Because blood cannot be manufactured artificially and has a limited storage period, blood banks must manage the collection, storage, and distribution of blood efficiently to ensure that the right blood type is available whenever required. Many hospitals and blood banks still rely on manual procedures or partially computerized systems to maintain donor records, blood stock, and patient requests. Information is often stored in paper files, spreadsheets, or independent software applications that are not interconnected. These traditional approaches make it difficult to maintain accurate records, retrieve information quickly, and monitor blood availability in real time. Manual data handling also increases the likelihood of duplicate entries, missing records, delayed updates, and human errors, all of which can negatively affect patient care during emergency situations. The rapid growth of web technologies, database systems, and intelligent software has created new opportunities for improving healthcare management. Web-based applications provide centralized access to information, allowing multiple users to interact with the system securely from different locations. In blood bank management, such applications simplify donor registration, blood request processing, inventory monitoring, and administrative activities while ensuring that information remains accurate and readily accessible. Automated workflows reduce paperwork, improve operational efficiency, and enable healthcare providers to deliver faster and more reliable services. The proposed Online Blood Donation Management System is designed as a comprehensive web application that integrates all major blood bank operations into a single digital platform. Registered donors can create accounts, manage their personal profiles, review their donation history, and participate in blood donation campaigns. Patients can search for required blood groups, submit blood requests online, and monitor the status of their applications without visiting the blood bank. Administrators are provided with dedicated tools to verify donor information, process blood requests, supervise blood inventory, and generate reports for effective management and decision-making. A key feature of the proposed system is its automated blood inventory management. Every approved blood donation or blood issue instantly updates the available stock within the centralized database, ensuring that inventory information always reflects the current status. This real-time synchronization minimizes manual intervention, prevents inconsistencies in stock records, and enables administrators to identify shortages quickly so that timely donation drives can be organized whenever necessary. To improve user interaction and provide continuous assistance, the application incorporates an Artificial Intelligence (AI)-powered chatbot. The chatbot responds to frequently asked questions regarding blood donation eligibility, blood group compatibility, donation procedures, blood request status, and blood availability. By providing immediate and accurate responses through a conversational interface, the chatbot enhances the overall user experience while reducing the routine workload of blood bank staff. The system also prioritizes data security and operational reliability through role-based authentication, secure login mechanisms, and controlled database access. Different categories of users—including administrators, donors, and patients—are granted access only to the features and information relevant to their responsibilities. This approach protects confidential healthcare data while maintaining data integrity and accountability throughout the system. The proposed Online Blood Donation Management System demonstrates how modern web technologies, centralized database management, intelligent automation, and AI-driven support can transform conventional blood bank operations into an efficient digital service. The application improves communication among donors, patients, and administrators, increases the accuracy of blood inventory management, reduces administrative effort, and enables quicker response during emergencies. Its scalable architecture also provides opportunities for future enhancements such as cloud deployment, mobile application support, integration with hospital information systems, automated notifications, predictive analytics, and advanced AI capabilities, making it a sustainable solution for next-generation blood bank management.

Literature Review:

The rapid advancement of information technology has transformed healthcare by introducing computerized systems that improve the efficiency, accuracy, and reliability of medical services. Blood

bank management has benefited considerably from these developments, as digital platforms have replaced manual record-keeping for donor information, blood inventory, and patient requests. Early computerized blood bank systems focused mainly on storing donor records electronically and reducing paperwork. Although these solutions simplified administrative activities, they offered limited automation and were unable to provide real-time monitoring of blood availability or effective communication among stakeholders. Various researchers have developed web-based blood donation management applications to improve access to blood bank services and simplify operational processes. These applications typically allow donors to create online accounts, update personal information, and receive notifications about blood donation events. Patients can request blood through online portals, while administrators monitor donor records and blood stock using centralized databases. Such systems have reduced manual errors, improved record management, and increased transparency in daily operations. However, many of these applications are restricted to basic data management and do not provide complete automation for blood request approval, stock synchronization, or intelligent user assistance. Recent research emphasizes the importance of maintaining accurate and continuously updated blood inventories. Real-time inventory management enables healthcare organizations to monitor blood availability more effectively and respond quickly during emergency situations. Automated stock management immediately reflects every blood donation and blood issue within the database, reducing inconsistencies caused by manual updates. Accurate inventory information supports better planning, minimizes blood shortages, prevents unnecessary wastage, and improves overall resource utilization within blood banks. Artificial Intelligence (AI) has become an important component of modern healthcare systems by providing intelligent assistance and improving user interaction. AI-driven chatbots are increasingly integrated into healthcare applications to answer common questions without requiring direct intervention from medical staff. Technologies such as Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG) enable chatbots to understand natural language queries and generate meaningful responses using relevant stored information. Within blood bank applications, these intelligent assistants provide guidance on donor eligibility, blood group compatibility, donation procedures, blood availability, and request tracking, thereby improving accessibility while reducing administrative workload. Modern healthcare applications also rely on secure database technologies, cloud-based infrastructure, and role-based authentication to ensure reliable system performance and data protection. Centralized databases improve data consistency by allowing multiple users to access updated information simultaneously. Authentication and authorization mechanisms restrict system access according to user roles, ensuring that sensitive information related to donors, patients, and blood inventory remains protected from unauthorized access or modification. These security measures improve confidentiality, maintain data integrity, and strengthen the overall reliability of healthcare information systems.

Despite the considerable progress achieved in digital blood bank management, many existing solutions still exhibit important limitations. Several applications lack integrated features such as automated inventory synchronization, AI-based user support, centralized workflow management, secure access control, and scalability for future technological expansion. In addition, support for mobile platforms, cloud deployment, and integration with hospital information systems is often unavailable, limiting the effectiveness of these systems in large healthcare environments. The proposed Online Blood Donation Management System has been designed to overcome these shortcomings by integrating multiple advanced technologies into a single web-based platform. The system combines centralized database management, automated blood request processing, live inventory tracking, role-based security, and an AI-powered chatbot to create a comprehensive solution for blood bank administration. This integrated architecture improves operational efficiency, enhances user satisfaction, reduces manual intervention, and provides a scalable foundation for future enhancements in modern healthcare management.

Existing System:

Blood banks are essential healthcare facilities responsible for collecting, storing, and distributing blood to hospitals and patients whenever required. Despite technological advancements, many blood banks continue to rely on traditional methods for managing their daily activities. Information related to donors, blood stock, and patient requests is often maintained using paper registers, spreadsheet software, or isolated desktop applications. Since these systems are not fully integrated, managing and retrieving information becomes slow, inefficient, and prone to mistakes. In the current approach, processes such as donor registration, blood request handling, inventory updates, and approval of blood distribution are either carried out manually or supported by basic software with limited functionality. During emergency situations, blood availability is commonly confirmed through physical records or by contacting blood bank staff directly. This manual verification process increases response time and may delay the delivery of blood to patients who require immediate medical attention. Likewise, patients are often required to visit the blood bank or make several phone calls to check blood availability and obtain updates on their requests, resulting in inconvenience and communication delays. A major drawback of the existing system is the lack of automated inventory management. Blood stock information is generally updated manually after each donation or blood issue, making the records vulnerable to human errors, duplicate entries, and inconsistencies. Inaccurate inventory data can lead to incorrect information about available blood units, making it difficult for administrators to monitor shortages, plan donation campaigns, or utilize blood resources efficiently. Another weakness of many traditional blood bank systems is inadequate security. Several applications do not implement proper authentication or role-based access control, allowing unauthorized users to access or modify sensitive information. Records related to donors, patients, and blood inventory may therefore be exposed to accidental changes or security risks. Additionally, many existing systems provide limited support for maintaining complete donor histories, monitoring blood requests, generating reports, or tracking inventory movements, increasing the administrative workload and reducing operational efficiency. Most conventional blood bank management applications also lack intelligent support mechanisms for users. Questions regarding blood donation eligibility, blood group compatibility, donation intervals, blood request procedures, and blood availability are usually answered manually by staff members. Handling these repetitive inquiries consumes valuable time and reduces the ability of administrators to focus on critical operational tasks, especially during emergencies or periods of high demand.

Although computerized blood bank applications have improved record maintenance compared to paper-based systems, many still fail to provide features such as centralized database management, automatic workflow execution, live inventory tracking, secure user authorization, and AI-powered assistance. These shortcomings demonstrate the need for a modern, web-based blood donation management system that can deliver accurate information, improve operational efficiency, strengthen data security, and provide faster, more reliable healthcare services.

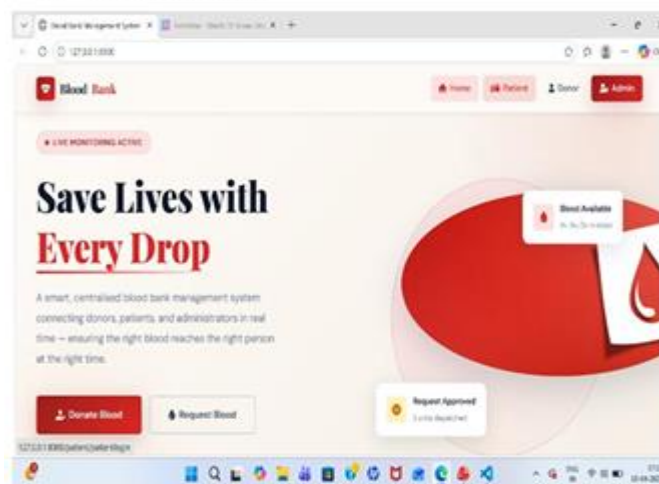
Proposed System:

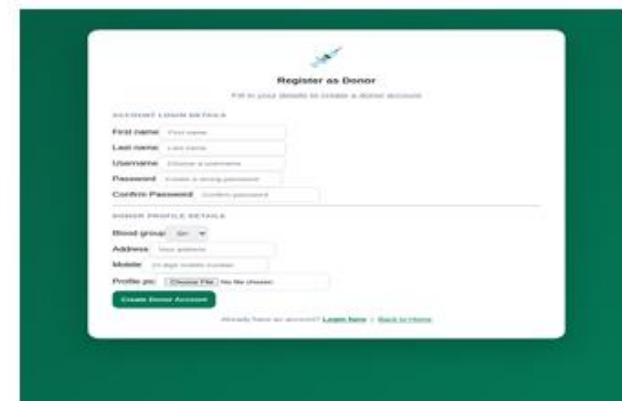
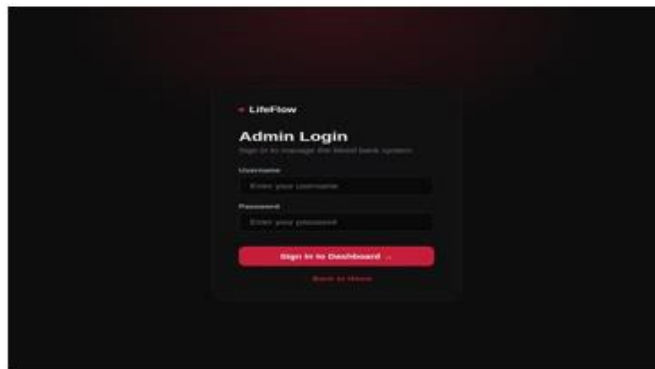
The proposed Online Blood Donation Management System is an advanced web application developed to digitize and streamline the complete blood donation process. It serves as a centralized platform that enables donors, patients, and blood bank administrators to interact efficiently through a secure online environment. By replacing manual record-keeping with an integrated database system, the application improves data accuracy, minimizes redundancy, and allows quick access to information whenever required. The application is built using the Django framework and is designed with a role-based access model to ensure that every user is provided with appropriate permissions. Registered donors can create and manage their profiles, update personal details, view previous donation records, and participate in upcoming blood donation drives. Patients can search for the required blood group, submit blood requests online, and track the progress of their requests without the need to visit the blood bank physically. Administrators have complete authority to validate donor registrations, approve or reject

blood requests, maintain blood stock, and monitor overall system activities through an administrative dashboard. An important feature of the system is its automated blood inventory management module. Whenever blood is collected from a donor or supplied to a patient, the inventory is updated instantly within the database. This automated process removes the need for manual stock calculations, reduces the possibility of duplicate entries, and provides an accurate view of available blood units at all times. The real-time inventory information enables blood banks to identify shortages promptly and organize donation campaigns before critical situations arise. To enhance communication and provide immediate assistance, the system includes an Artificial Intelligence (AI)-powered chatbot. The chatbot is capable of answering commonly asked questions related to donor eligibility, blood group compatibility, donation guidelines, blood request procedures, and stock availability. Users receive instant responses without waiting for administrative support, improving accessibility while reducing the workload of blood bank personnel. Security is another major component of the proposed solution. The application implements secure authentication, role-based authorization, server-side input validation, and protected database operations to safeguard sensitive information. Every activity performed within the system, including registrations, donations, blood requests, and inventory updates, is recorded for monitoring and auditing purposes. This approach enhances accountability while maintaining data integrity and confidentiality. The proposed Online Blood Donation Management System offers a reliable and efficient solution for managing blood bank operations through digital technology. The integration of automated workflows, centralized database management, intelligent chatbot support, and live inventory tracking significantly improves the speed and quality of blood bank services. The modular design of the application also supports future enhancements such as cloud-based deployment, mobile application support, integration with hospital information systems, automated notification services, predictive analytics, and more sophisticated AI functionalities to further strengthen healthcare service delivery.

Result:

1. Home Page

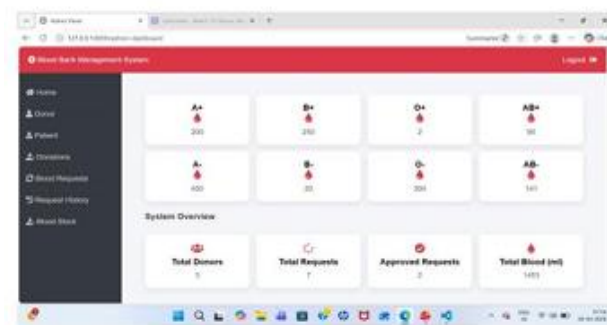
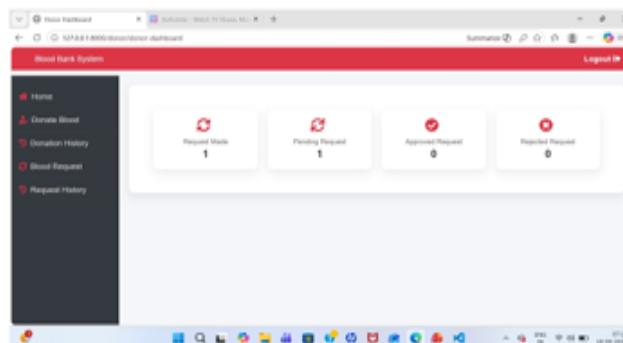
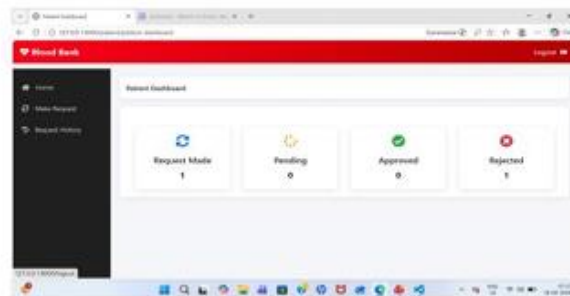




4. Patient Portal



5.Admin panel



[illegible]

The Online Blood Donation Management System is designed to modernize and simplify the management of blood donation services through a unified web-based application. It combines essential functions such as donor registration, patient information management, blood request handling, blood stock maintenance, and administrative operations into a single platform. Automating these activities eliminates many limitations associated with manual record keeping, including duplicate entries, delayed processing, and human errors, resulting in a more accurate and efficient workflow. A major strength of the system is its dynamic blood inventory management, which updates blood availability immediately after donations, approvals, or issue transactions. This enables blood banks and healthcare institutions to maintain reliable stock information and respond more effectively during emergencies. Secure role-based authentication ensures that each category of user—including administrators, donors, and patients—can access only the information and services relevant to their responsibilities, thereby improving both security and operational control. The integration of an Artificial Intelligence (AI) chatbot further enhances the platform by offering instant responses to frequently asked questions related to blood donation eligibility, blood group compatibility, registration procedures, and blood request status. This intelligent assistance improves user engagement, reduces dependency on administrative staff for routine inquiries, and ensures that users receive timely guidance at any time. The system demonstrates the practical benefits of combining modern web development technologies with centralized database management and intelligent automation. It promotes effective communication among donors, recipients, and blood bank administrators while maintaining transparency, data consistency, and efficient utilization of blood resources. Its modular and scalable architecture also allows the application to be adapted easily to the operational requirements of hospitals, blood banks, and healthcare organizations of different capacities. The proposed Online Blood Donation Management System provides a dependable and technology-driven solution for improving blood donation management and healthcare service delivery. By ensuring accurate inventory tracking, secure data management, faster blood request processing, and AI-assisted user support, the system contributes to better patient care and operational efficiency. Future improvements may include cloud-based deployment, dedicated mobile applications, integration with hospital information systems, predictive analytics for blood demand forecasting, and more advanced AI features to further enhance decision-making, accessibility, and large-scale healthcare support.

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