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AI-Based Blood Management

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***Abstract*—AI-Based Blood Management System is a web-based platform designed to efficiently manage blood donation, blood availability, and blood requests through a centralized system. The system connects blood donors, patients, hospitals, blood banks, and administrators on a single platform. Users can register and provide details such as blood group, location, availability, and contact information. An intelligent AI-based matching mechanism analyses blood group, location, availability, and urgency to identify suitable blood donors or available blood units for patients in need. Patients and hospitals can search for available blood based on blood group, quantity, location, and requirement, while donors can manage their profiles and donation availability. The system also maintains records of blood donations, requests, inventory, and donor history. An administrator manages users, blood banks, requests, donations, verification, and system activities. The AI component helps prioritize urgent requests, predict blood demand, and improve donor matching and inventory management. The project aims to make blood searching, requesting, donating, and management faster, organized, reliable, and accessible, thereby reducing delays in critical blood requirements.**

***Index Terms*—AI-Based Blood Management System, blood bank management, blood donation, blood donor matching, blood availability, intelligent donor recommendation, blood request management, blood inventory management, emergency blood requests, donor verification, blood demand prediction, hospital management.**

I. INTRODUCTION

Blood is an essential resource required during accidents, surgeries, medical emergencies, and various treatments. However, finding the required blood group at the right time can be difficult and time-consuming. Blood donors and available blood units are often identified through personal contacts, hospitals, blood banks, social media, or different platforms. These approaches can make

it difficult to quickly check blood availability, find suitable donors, and manage blood requests and inventory efficiently.

AI-Based Blood Management System addresses this problem through a centralized web-based platform for managing blood donors, patients, hospitals, blood banks, blood requests, and blood inventory. The system has three main user types: Donor, Patient/Hospital, and Admin. A user can submit a blood requirement by providing details such as blood group, location, required quantity, and urgency. The AI-based matching module analyses these requirements and identifies suitable donors or available blood units based on blood group, location, availability, and urgency.

The proposed system combines blood donor registration, blood availability, donor profiles, verification, blood requests, donation records, inventory management, and request tracking. The AI component can also assist in prioritizing emergency requests, recommending suitable donors, and predicting future blood demand. The system aims to reduce the time required to find blood, improve blood inventory management, and make the overall blood donation and management process faster, organized, and reliable.

II. PROBLEM STATEMENT AND OBJECTIVES

The problem addressed by the AI-Based Blood Management System is the lack of a centralized platform that can help patients, hospitals, and blood banks quickly find suitable blood donors or available blood units. Traditional methods can be time-consuming, especially during emergency situations. The proposed system uses AI-based matching to improve blood availability and management.

Main Objectives

1. To provide a centralized platform for blood donors, patients, hospitals, and blood banks.
2. To maintain donor, blood request, donation, and inventory records.
3. To find suitable blood donors or available blood units based on blood group, location, availability, and urgency.
4. To use AI-based matching for faster and more efficient donor selection.
5. To provide an admin dashboard for managing users, donors, requests, and blood inventory.

III. RELATED WORK

The literature considered in the project synopsis focuses on blood donation, blood bank management, donor matching, and intelligent blood inventory systems. Research on online blood bank platforms provides a basis for managing blood availability and donor information. Studies on blood donor management highlight the importance of maintaining donor records, blood groups, availability, and donation history. Research on intelligent donor-matching systems supports the use of AI for identifying suitable donors based on blood group, location, availability, and emergency requirements. Blood inventory management research provides a foundation for monitoring available blood units and reducing shortages or wastage.

AI-Based Blood Management System	Relevant Research	Relevance
Blood Donor Management	Web-based blood donor management systems	Managing donor registration, blood groups, contact details, and donation history.
Blood Bank Management	Digital blood bank and inventory management systems	Tracking blood availability, blood units, expiry, and inventory records.
AI-Based Donor Matching	Intelligent blood donor–recipient matching systems	Matching suitable donors based on blood group, location, availability, and urgency.
Emergency Blood Requests	Online emergency blood request and donor-search platforms	Helping patients and hospitals find required blood quickly during emergencies.
Blood Demand Prediction	AI and machine learning approaches for blood demand forecasting	Predicting future blood requirements and supporting better inventory management.

IV. PROPOSED CARECONNECT AI PLATFORM

The AI-Based Blood Management System provides a centralized web platform for managing blood donors, patients, hospitals, blood banks, blood requests, and blood inventory. Registration, blood requirement submission, AI-based donor matching, donor profiles, verification, blood requests, availability management, inventory tracking, emergency prioritization, and administration are the main system features.

The user flow is: User Registration/Login → Select Blood Requirement → Enter Blood Group, Quantity, Location & Urgency → AI-Based Matching → Recommended Donors/Available Blood Units → View Donor/Blood Details → Send Blood Request → Donor/Blood Bank Accepts Request → Blood Availability Confirmed → Blood Collection/Issue → Request Completed → Update Blood Records & Inventory.

V. SYSTEM ARCHITECTURE AND IMPLEMENTATION

A. User/Patient Module

User can register and log in, submit blood requirements, enter details such as blood group, required quantity, location, and urgency, view suitable donors or available blood units, send blood requests, track request status, and view blood availability.

B. Donor Module

Blood donors can register and log in, maintain their profiles, provide blood group and location details, update their availability, view blood requests, accept or reject requests, and maintain their donation history.

C. AI-Based Matching Module

The matching module compares the patient's blood requirements with donor and blood-unit information. The main matching factors include blood group, location, availability, urgency, and eligibility. A conceptual matching score can be represented as:

$M = w_1G + w_2L + w_3A + w_4U + w_5E$

where G represents blood-group compatibility, L represents location, A represents availability, U represents urgency, and E represents donor eligibility. The exact weights can be determined and evaluated during implementation.

D. Blood Request and Management Module

The blood request module records the patient/hospital, blood group, required quantity, location, urgency, date, and request status. Users can submit and track blood requests, while donors or blood banks can respond to the requests.

E. Blood Inventory Module

The system maintains records of available blood units, blood groups, quantities, collection dates, expiry dates, and availability status. The inventory can be updated when blood is donated, issued, or received.

F. Blood Donation Module

The system maintains donor donation records, including donor details, blood group, donation date, and donation history. This helps in maintaining organized donor information and supporting future blood requirements.

G. Verification Module

The administrator can verify donor and blood-bank information and maintain their verification status. Verified information can be displayed to users to improve the reliability of the system.

H. Admin Module

The administrator manages users, donors, blood requests, blood inventory, verification, donation records, reports, and other system data through a centralized dashboard.

I. Technology Stack

The proposed implementation uses React.js, HTML, CSS, and JavaScript for the frontend; Node.js and Express.js for backend services; and MongoDB or MongoDB Atlas for database management. AI-based matching can be implemented using Python and suitable machine-learning libraries

where required. Visual Studio Code, a web browser, and Git/GitHub can be used for development. The system can be developed on Windows or Linux platforms

VI. METHODOLOGY

The methodology consists of requirement analysis, system design, frontend development, backend development, database design, AI-based donor matching, blood inventory management, testing, and deployment. Requirement analysis identifies the needs of patients, donors, hospitals, blood banks, and administrators. System design defines the user interface, database, architecture, and system modules. Frontend pages include Home, Login, Register, Patient Dashboard, Donor Dashboard, Blood Requirement, Matching Results, Donor Profile, Blood Request, Blood Availability, and Admin Dashboard. The backend handles registration, login, donor information, blood requests, AI-based matching, blood inventory, donation records, and request tracking. MongoDB stores users, donors, blood requests, blood units, donations, and inventory records. AI-based matching considers factors such as blood group, location, availability, urgency, and donor eligibility to recommend suitable donors or available blood units. Testing covers registration, login, donor matching, blood requests, inventory updates, request status, donor responses, and administrative functions. Finally, the system is deployed on a suitable web server for access by authorized users.

VII. INNOVATION AND SYSTEM ANALYSIS

The major proposed contributions of the AI-Based Blood Management System are the centralized management of blood donors, patients, hospitals, blood banks, blood requests, and inventory; AI-based donor matching; blood availability tracking; emergency request prioritization; donor verification; centralized blood request management; and blood demand prediction. These features are intended to reduce the time required to find suitable blood, improve donor selection, and support efficient blood inventory management. The system focuses on providing a faster, organized, and reliable approach to blood management during both regular and emergency requirements. The synopsis defines expected outcomes rather than completed experimental measurements. Therefore, no accuracy, precision, recall, or user-study values are claimed in this review paper. During implementation, the AI-based matching module can be evaluated using appropriate test cases and real or sample donor and blood request data.

VIII. EXPECTED OUTCOMES

- A single platform for blood donors, patients, hospitals, and blood banks.
- Faster searching for suitable blood donors and available blood units.
- AI-based donor recommendations based on blood group, location, availability, and urgency.
- Organized donor information including blood group, location, availability, eligibility, and donation history.

- Easier blood request and tracking.
- Better management of blood inventory and availability.
- Improved handling of emergency blood requirements.
- Centralized management of users, donors, blood requests, donations, and inventory.

IX. ADVANTAGES AND LIMITATIONS

Advantages include centralized blood management, an easy-to-use interface, AI-based donor matching, reduced search time, quick identification of suitable blood donors, blood availability tracking, emergency blood request management, donor information, verification, donation history, inventory management, and centralized administration.
Limitations include that matching depends on the accuracy of donor and blood-bank information; real-time location may require a location/maps API; donor identity or eligibility verification may require external services; the college prototype may use sample donor and blood data; accurate blood inventory requires regular updates from blood banks; AI-based predictions depend on sufficient and reliable historical data; and an internet connection is required.

X. FUTURE SCOPE

- Android and iOS mobile applications.
- Advanced AI and machine-learning models for donor matching and blood demand prediction.
- GPS and map integration for real-time donor and blood-bank location.
- SMS, email, and push notifications for urgent blood requests.
- Marathi, Hindi, and other language support.
- Advanced donor identity and eligibility verification.
- AI chatbot and voice-based blood search and request assistance.
- Real-time blood inventory integration with hospitals and blood banks.
- Improved prediction of blood demand and shortages.
- Advanced admin analytics and emergency blood assistance features.

XI. CONCLUSION

The AI-Based Blood Management System proposes a centralized web-based approach to managing blood donors, patients, hospitals, blood banks, blood requests, and blood inventory. The system supports donor registration, blood requirement submission, AI-based donor matching, blood availability tracking, donor verification, blood requests, donation records, inventory management, and emergency blood assistance. By bringing blood searching, donor matching, and inventory management into one organized platform, the proposed system aims to reduce the time required to find suitable blood and improve the efficiency and reliability of blood management. The project also provides a foundation for future improvements such as advanced machine learning

models, mobile applications, GPS and map integration, real-time blood-bank connectivity, multilingual support, AI chatbot assistance, and improved blood demand prediction.

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