AI-Enabled Healthcare Platform for Organ Donation and Transplant Matching

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Abstract:

Organ donation plays a vital role in modern healthcare by providing life-saving treatment to patients with organ failure. However, traditional organ allocation systems often suffer from fragmented medical records, manual coordination, and communication delays, which reduce the efficiency and timeliness of transplant decisions. To overcome these limitations, this project proposes an AI-based organ donation and organ matching system that integrates intelligent automation and user-friendly digital services within a unified platform. The system digitizes donor registration and hospital organ requests through secure authenticated access, ensuring accurate and centralized storage of medical and demographic information. Organ compatibility is determined using the Random Forest algorithm, which analyzes multiple parameters such as blood group, tissue type, age, medical urgency, geographic distance, and patient history to generate compatibility scores and rank the most suitable donor–recipient pairs. This approach provides high accuracy, stability with incomplete clinical data, and reliable real-time performance. In addition, the platform incorporates an AI chatbot to assist donors, patients, and hospital staff by answering enquiries related to organ donation procedures, eligibility criteria, registration steps, organ availability, and application status. The chatbot reduces administrative workload while enabling 24/7 access to essential information. To enhance security and transparency, the system integrates a Private Blockchain to record all organ donation activities. Each transaction, including registration, matching, and approval, is stored as an immutable block, ensuring tamper-proof records and traceability. Access is restricted to authorized users, maintaining privacy and accountability. The system further includes role-based access control, real-time notifications, and an administrative dashboard for monitoring donation trends, allocation status, and system performance. By automating workflows, improving matching accuracy using Random Forest, enhancing communication through AI-driven assistance, and ensuring secure transaction recording using Private Blockchain, the proposed solution significantly reduces allocation delays, increases transparency, and strengthens the overall effectiveness of organ donation management

INTRODUCTION:

The system requires both hardware and software components to ensure efficient performance, secure data handling, and reliable organ allocation management. The system utilizes technologies such as the Random Forest algorithm, AI chatbot integration, Private Blockchain, and centralized database management to automate donor registration, organ matching, and hospital coordination processes. Proper system requirements are essential for maintaining security, real-time communication, scalability, and smooth operation of the platform. The system is designed to support multiple users simultaneously with stable processing and fast response time. It also requires secure network connectivity and adequate storage capacity to manage sensitive medical and transaction records efficiently.

2.Literature Survey:

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3.Exixsting System:

- **Manual Organ Allocation Systems**

Traditional organ donation systems rely heavily on manual processes where hospitals and coordinators manage donor and recipient data separately. Matching is done by reviewing medical records and coordinating through phone calls or emails. This approach depends on human judgment and experience to identify suitable donor–recipient pairs.

- **Hospital-Based Record Management Systems**

Many hospitals maintain their own internal databases to store donor and patient information. These systems help in organizing medical data within a single hospital but operate independently without integration with other healthcare institutions, limiting broader data sharing.

- **Rule-Based Matching Systems**

Some existing systems use predefined medical rules to match donors and recipients. These rules are based on factors such as blood group compatibility, organ type, and urgency level. The system follows fixed conditions to determine matches rather than learning from data patterns.

- **Centralized Government Organ Allocation Systems**

National and regional organizations manage centralized organ allocation through structured databases. These systems collect donor and recipient data from multiple hospitals and follow standardized procedures for organ distribution and prioritization.

- **Basic Online Registration Portals**

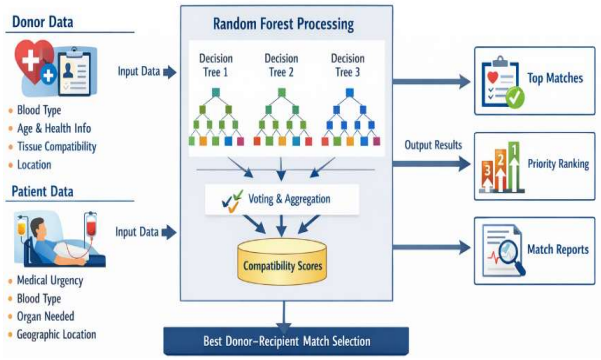
Existing platforms provide online registration for donors and hospitals to submit information digitally. These portals allow users to enter details and track basic application status, improving accessibility compared to fully manual systems.

4.Propose System:

The proposed system is an AI-enabled healthcare platform designed to improve the efficiency, accuracy, and security of organ donation and transplant matching. It integrates advanced technologies such as Machine Learning, Private Blockchain, and chatbot support to automate the entire process from donor registration to transplantation, ensuring transparency, faster decision-making, and reliable communication.

- **Random Forest Algorithm for Organ Matching**

The system uses the Random Forest algorithm to perform intelligent donor–recipient matching. It analyzes multiple medical and non-medical parameters such as blood group, organ type, tissue compatibility, age, urgency level, medical history, and geographic location.



Multiple decision trees are trained on the dataset, and their combined output provides a highly accurate compatibility score. Based on these scores, the system ranks donors and helps hospitals select the most suitable match quickly and efficiently.

- **Private Blockchain for Secure Transactions**

A Private Blockchain is integrated to securely record all system activities, including donor registration, patient requests, matching results, approvals, and transplant status updates. Each transaction is stored as an immutable block, ensuring that data cannot be altered or deleted.

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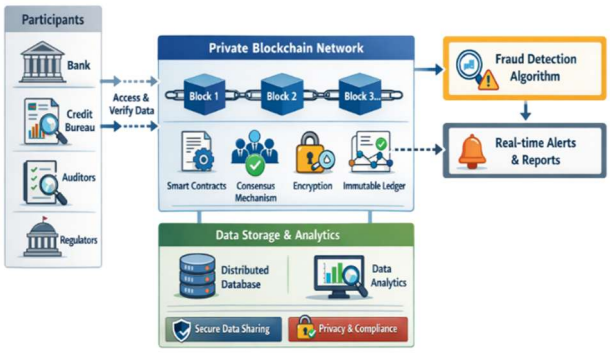
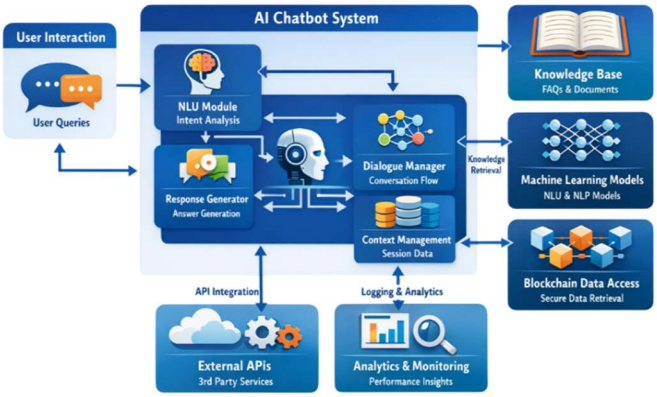


This enhances transparency, builds trust among stakeholders, and provides complete traceability of organ allocation while restricting access only to authorized participants.

- **AI Chatbot for User Assistance**

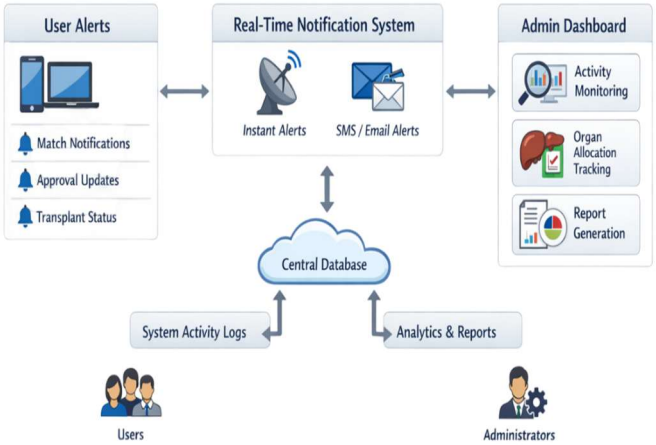
The system includes an AI-powered chatbot that provides instant responses to user queries. It assists donors, patients, and hospital staff by answering questions related to eligibility, registration procedures, organ availability, and request status.



The chatbot operates continuously, reducing the workload of administrative staff and improving user experience through real-time support.

- **Notification and Monitoring System**

The system includes a real-time notification mechanism that alerts users about important updates such as matching results, approval status, and transplant completion.



Additionally, an administrative dashboard is provided to monitor system activities, track organ allocation, and generate reports, helping administrators make informed decisions and maintain system performance.

5.System Architecture:

System architecture defines the overall structure and organization of components and how they interact with each other. It includes the user interface, backend processing, database, machine learning module, chatbot, blockchain, and notification system. Each component is connected to ensure smooth data flow and efficient processing. The architecture supports centralized data management and secure communication between modules. It also enables scalability and easy integration of advanced technologies. This structured design helps in achieving reliable and high-performance system operations

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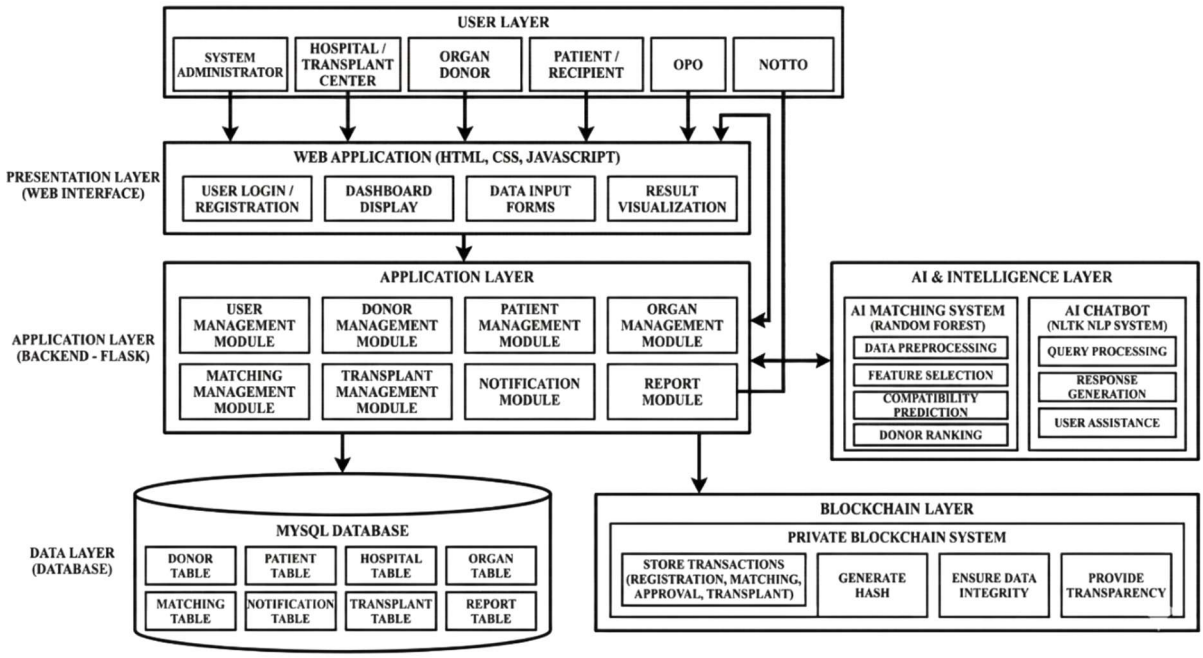
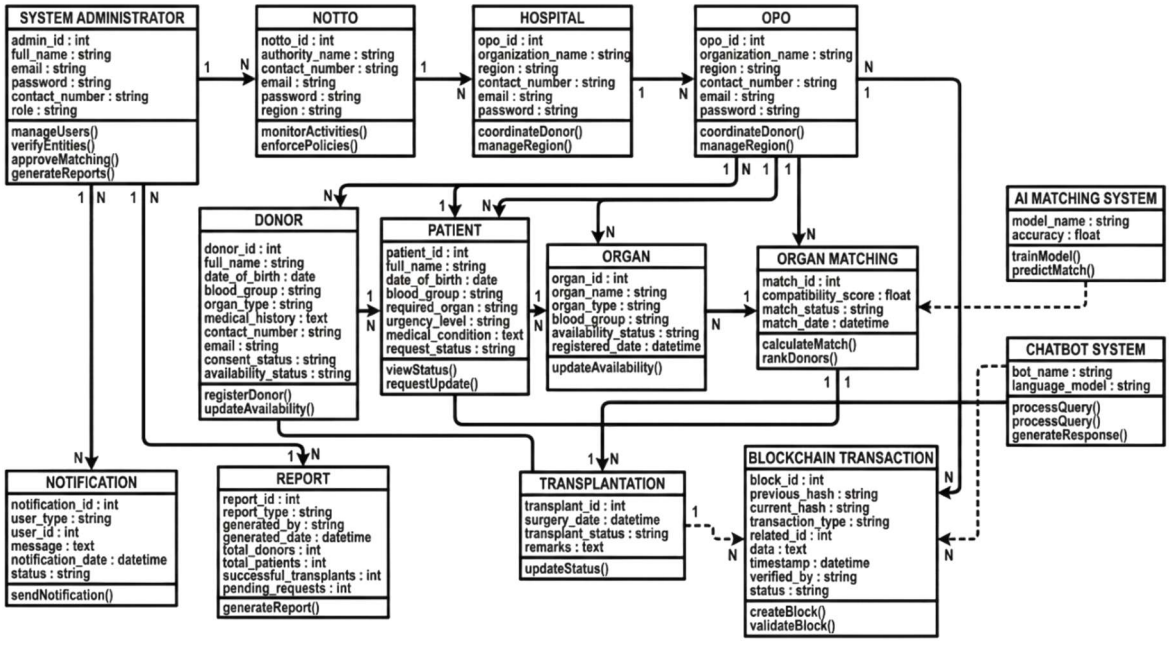


6.Class Diagram:

Class diagrams describe the structural design by showing classes, attributes, methods, and relationships. They represent how data and functionalities are organized. This diagram is useful for designing the database and object-oriented structure. It ensures proper organization of system components.



7.Future Enhancement:

- **Predictive Analytics for Organ Demand**

The system can be extended to include predictive analytics to forecast organ demand based on historical data. This will help healthcare organizations plan better and manage resources efficiently. It can also assist in identifying trends and improving organ allocation strategies.

- **Integration with Government and Legal Systems**

Future versions can integrate with government databases and legal frameworks for better regulation and compliance. This will ensure proper verification of donor consent and adherence to legal policies. It will also improve transparency and trust in the system.

8.Conclusion:

In conclusion, this project presents an intelligent and secure system for managing organ donation and transplant matching by integrating advanced technologies and automation. The system effectively utilizes the Random Forest algorithm to analyze multiple medical and demographic factors such as blood group, organ type, urgency level, and patient history to accurately predict donor–recipient compatibility. This algorithm improves matching accuracy, reduces manual effort, and supports faster decision-making. The implementation of a Private Blockchain ensures secure, transparent, and tamper-proof recording of all transactions, enhancing trust and accountability in the organ allocation process. Additionally, the integration of an AI chatbot using Natural Language Processing provides real-time assistance to users, improving accessibility and user experience. The notification system further ensures timely communication between stakeholders. Thus, the system successfully addresses key challenges such as data fragmentation, lack of transparency, and delays in matching. By combining machine learning, blockchain technology, and intelligent automation, the project enhances efficiency, reliability, and coordination in organ donation management. This solution has the potential to improve transplant success rates and contribute significantly to saving lives.

9.References:

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