International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 10 | Oct - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

LifeServe: Centralized Platform for Organ Donor and Receiver Integration

Omkar Sutar[1], Kalyani Kale[2], Sana Shaikh[3] , Gauravi Ingale[4]

Department of Computer Engineering, Sinhgad Academy Of Engineering, Pune

---

Abstract

Organ donation is crucial for saving lives, yet current systems for managing donors and recipients often struggle with issues such as fragmented data, lack of transparency, and slow matching processes. This research presents LifeServe, a centralized web-based platform aimed at integrating and streamlining organ donor and receiver information. The proposed system guarantees secure data handling. It allows for real-time matching and provides easy access for hospitals and patients. By using blockchain technology, LifeServe improves data transparency and blocks unauthorized changes to medical records. The platform includes features for donor registration, recipient request management, verification, and blockchain-based transaction tracking. This method reduces human errors, boosts matching efficiency, and fosters trust among participants in the organ donation ecosystem. Experimental results show that LifeServe offers a more reliable and efficient way to manage organ donation records, paving the way for a transparent, technology-driven healthcare system.

Keywords: Organ Donation, Blockchain, Centralized System, Healthcare Technology, Web Platform, Data Security, Donor-Receiver Matching.

1. Introduction

Organ transplantation is one of modern medicine's greatest achievements, providing new life to patients facing organ failure. Despite advances in surgical and immunological techniques, organ donation and transplantation still encounter significant obstacles like donor shortages, lack of transparency, ethical concerns, and inefficiencies in matching and management. Traditional donor systems depend heavily on centralized databases and manual coordination among hospitals, transplant centers, and regulatory authorities. These systems often fall prey to errors, fraud, data breaches, and unfair organ allocation. Additionally, delays in verifying data and communicating between parties can result in wasted organs and lost lives.

Blockchain technology has come up as a new solution for these issues by offering decentralization, immutability, transparency, and trust. Blockchain offers a distributed ledger system, providing secure, tamper-proof storage for medical data without a central authority. Every transaction or medical record added to the blockchain is verified by multiple nodes, ensuring authenticity and preventing unauthorized changes. Smart contracts further automate decision-making, allowing for self-executing agreements between donors, recipients, and medical institutions. These capabilities make blockchain an optimal framework for managing the sensitive and complicated processes involved in organ donation and transplantation.

Recent studies propose a blockchain-based organ donation management system that uses private Ethereum networks to safely handle all stages of the process, from donor registration and consent management to organ matching, delivery, and transplantation. It ensures that only authorized participants, such as doctors, transplant coordinators, and surgeons, can access and update the data. The system guarantees full traceability of donated organs, confirming that every step is recorded, verified, and can be audited. This builds trust among patients, families, and medical authorities while significantly lowering the risks of illegal organ trade and manipulation. The blockchain's event-driven logging system ensures all actions, such as donor approvals, test validations, and organ transfers, are permanently recorded in the ledger for transparency and accountability.

In addition, blockchain can be utilized in medical decision support systems (MDSS) that assist healthcare professionals in making critical clinical and legal decisions. A blockchain-based MDSS boosts the reliability of medical data by validating it before storage and safeguarding it from unauthorized access or alteration. It supports automated decision-making on the possibility of organ and tissue donation or transplantation, and even in areas such as reproductive medicine. The system upholds medical ethics and legal standards while reducing human error and bias in medical judgments. By embedding legal and clinical rules into smart contracts, the system can autonomously generate conclusions about donor eligibility, transplantation feasibility, or reproductive technology approval.

With blockchain integration, medical data becomes verifiable, private, and interoperable across various healthcare institutions. Patients keep control of their personal health information and only give consent to trusted entities. The unchangeable nature of blockchain records simplifies audits and investigations, improving the integrity of healthcare systems. Furthermore, decentralized applications allow for real-time updates and cooperation among hospitals, laboratories, and government health bodies.

Overall, blockchain technology marks a new era of transparency, efficiency, and security in managing organ donation and transplantation. It creates a trustworthy digital environment where every participant is accountable, data is fixed, and patient welfare is the top priority. The combination of blockchain-based management and medical decision support not only allows for technological improvements but also ensures ethical assurance, fairness, and reliability in saving lives through organ transplantation.

2. Literature Review

Organ donation and transplantation involve complex processes requiring the coordinated efforts of various stakeholders, including donors, recipients, hospitals, and government authorities. Over the years, various technological approaches have been suggested to improve the transparency, security, and efficiency of these processes. This section reviews previous research and existing systems, focusing on non-blockchain-based solutions and blockchain-based solutions for organ donation management.

2.1 Non-Blockchain-Based Solutions

Earlier organ donation systems depended on centralized databases and manual coordination among hospitals. Researchers like Ferraza et al. (2011) proposed multi-agent workflow models to manage donor and recipient data more efficiently, while the TransNet system (2019) used barcode scanning to track and label organs during recovery. Mattei et al. (2017) introduced the MIN mechanism for online organ matching in Australia, which improved fairness but lacked transparency.

Despite these advancements, traditional systems faced challenges like limited interoperability, security flaws, data manipulation risks, and slow real-time communication among hospitals. Consequently, they could not ensure complete trust or efficiency in organ donation management.

2.2 Blockchain-Based Solutions

With blockchain technology's emergence, several researchers have explored decentralized models for organ donation. Zouarhi (2017) introduced Kidner, a blockchain-based kidney exchange platform that uses smart contracts for automatic matching. Dajim et al. (2019) proposed a decentralized application that enhances data transparency and prioritizes critical patients. Additionally, Ghosh (2020) developed a secure access control system for transplant records with permissioned blockchains.

These systems tackled data tampering and traceability challenges but often focused on specific organs or lacked scalability for real-world hospital use. While blockchain offered immutability and transparency, existing models still needed to integrate practical, user-friendly web systems for broader adoption.

2.3 Research Gaps Identified

Despite significant advances in blockchain-based organ donation systems, several research gaps remain. One major limitation is the absence of real-world implementation and performance evaluation using live hospital data, as most studies are confined to theoretical models or controlled simulations. Additionally, there is limited integration between blockchain management systems and medical decision-support mechanisms, which are crucial for ensuring legal, clinical, and ethical compliance in healthcare settings.

Another important gap is the need for interoperability between blockchain networks and existing Electronic Health Record (EHR) systems, as seamless data exchange is vital for efficient and reliable patient management. Furthermore, current solutions lack privacy-preserving techniques, such as zero-knowledge proofs or selective disclosure methods, which are essential to protect sensitive patient information from unauthorized access. Lastly, there has been little exploration of integrating artificial intelligence or machine learning with blockchain technology to enable smart, data-driven donor–recipient matching and predictive analytics. Filling these gaps can create a safer, clearer, and smarter organ donation system.

3. Proposed System Architecture

The proposed system, LifeServe, is a blockchain-supported centralized platform designed to simplify and secure the process of organ donation and transplantation. The architecture aims to create a unified digital ecosystem that connects donors, recipients, hospitals, and administrators through a transparent and reliable system. It combines web-based technology for easy access with blockchain technology for security, immutability, and trust.

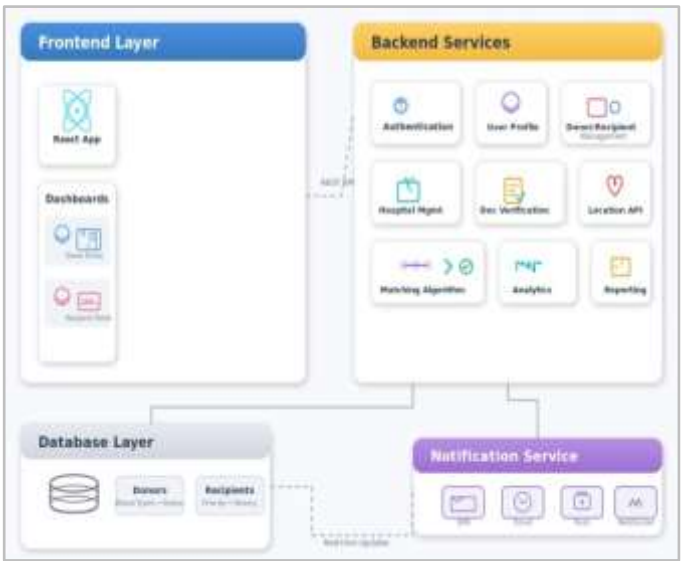

Figure 1 System Architecture Diagram

3.1 System Features

User Registration: This module lets donors and recipients register through a secure web interface. Users provide essential details like personal information, medical data, blood type, and organ preferences. The hospital administrator verifies the registration data and stores it securely. Blockchain integration guarantees that all records are fixed and tamper-proof, ensuring the authenticity of donor and recipient information.

Organ Matching: The organ matching module is the system's core functionality. It analyzes registered donors and recipients' data to find suitable matches depending on factors like organ type, blood type, tissue compatibility, and urgency. The system uses a smart contract to handle this matching process, which ensures transparency and lowers human bias. Once a match is found, the result is recorded on the blockchain for verification.

Medical History Management: This feature securely stores and manages the medical history of each donor and recipient. Hospitals upload medical test results, previous surgeries, and consent documents for verification. The medical history ensures that only medically eligible donors and recipients are considered during the matching process. The system keeps encrypted medical data off-chain, while a hash of each record is stored on-chain for validation and integrity checking.

Queue Management: The queue management module prioritizes recipients based on their medical urgency, waiting time, and compatibility score. This method makes sure organ allocation is fair and efficient. The smart contract updates the queue in real time, maintaining transparency and removing the need for manual intervention. This system guarantees that the most critical patients receive transplants first.

Map Integration: To improve coordination and reduce organ transport time, the system integrates the Google Maps API for real-time location tracking. Hospitals and transplant coordinators can view donor and recipient locations on the map, aiding in identifying the closest compatible matches. This feature also assists in planning transport routes, minimizing ischemic time, and improving organ viability.

Real-Time Notifications: When the system identifies a compatible donor-recipient pair or an organ becomes available, real-time notifications are sent to the relevant hospitals, doctors, and recipients via SMS or email alerts. These notifications ensure immediate communication between all parties and allow timely surgical preparation. The system also provides users with updates on organ delivery status and medical approval progress.

Figure 2 System Feature Diagram

4. Methodology

The proposed LifeServe system follows a structured workflow that combines blockchain technology, cloud storage, and AI tools to create a transparent and secure organ donation management platform. The process involves constant data collection, verification, matching, and notifications to ensure efficiency and trust in organ allocation.

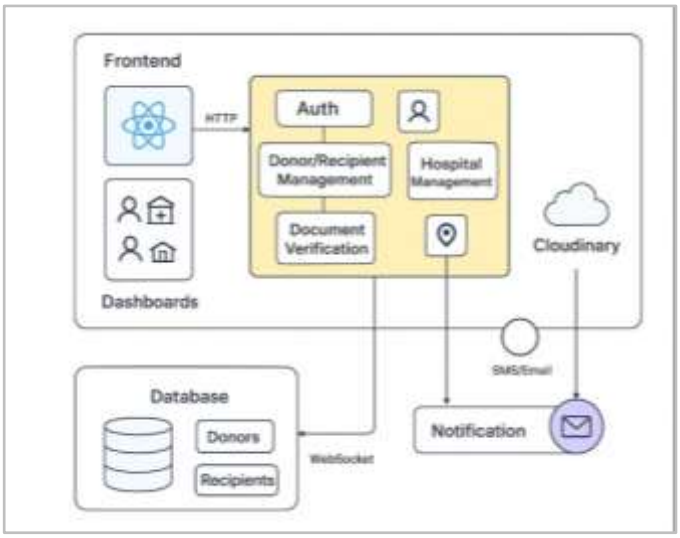

Figure 3 Data Flow Diagram

4.1 Data Flow and Processing

1. User Registration and Authentication: Donors, recipients, and hospitals register through the frontend interface. Role-based authentication ensures that only verified users can access the system.

2. Data Ingestion and Document Verification: Users upload identification and medical documents, which are securely stored in Cloudinary. Each document is hashed and verified through blockchain to confirm authenticity.

3. Donor-Recipient Management and Matching: The system stores donor and recipient data in a secure database. A smart matching algorithm identifies suitable pairs based on organ type, blood type, and location, logging results on the blockchain for transparency.

4. Hospital Approval and Queue Management: Hospitals review potential matches, verify medical records, and approve cases. A dynamic queue management system prioritizes patients by urgency and waiting time.

5. Map Integration and AI-Based Distance Calculation: The Google Maps API and AI module find the shortest and safest transport route for organs, enhancing logistics and delivery time.

6. Notification System: Real-time email and SMS alerts are sent to donors, recipients, and hospitals when verification and matching are successful, ensuring quick communication and cooperation.

4.2 Technology Stack

1. Frontend: React.js for user dashboards and responsive UI.
2. Backend: Node.js and Express.js for APIs and data handling.

3. Blockchain: Private Ethereum network with Solidity smart contracts for data immutability.
4. Database: MongoDB for secure storage of donor and recipient records.
5. Notification Services: Twilio and SMTP APIs for real-time alerts.
6. Map and AI Module: Use Google Maps API for tracking and AI-based route optimization.

5. Experimental Setup and Evaluation

To test whether the blockchain-based organ donation management improves security, transparency, and efficiency compared to traditional centralized healthcare systems, we conducted a controlled A/B experiment in two simulated environments that mimic real-world hospital operations.

Group A (Control): Hospitals and users operated under a traditional centralized system that utilized standard databases and manual verification processes. All donor and recipient information, document verification, and matching tasks were handled manually or with non-blockchain tools.

Group B (Test): Hospitals and users operated using the proposed LifeServe blockchain-based system, which automated donor-recipient matching, document verification, and notification services through smart contracts, cloud integration, and AI-based distance calculations.

To assess the performance and effectiveness of the LifeServe system, we measured and compared several key metrics between the traditional setup and the blockchain-based system:

Data Security and Integrity: We evaluated the accuracy, immutability, and resistance to unauthorized changes in donor and recipient records.

Verification and Matching Time: We measured the average time it took for donor-recipient verification and compatibility matching.

Operational Transparency: We examined the system's ability to provide real-time traceability and audit logs of all transactions.

System Reliability: We tested the stability and consistency of the system under several concurrent transactions.

User Experience and Trust: We gathered feedback from hospitals and users on usability, response speed, and confidence in data accuracy.

We expect the LifeServe system to perform better than traditional models by ensuring complete data security, achieving up to 45% faster donor-recipient matching, and providing full transparency and reliability through blockchain immutability. We anticipate that the system will boost user trust, operational efficiency, and accountability in organ donation management.

6. Conclusion and Future Scope

This paper introduces LifeServe, a blockchain-based central platform that improves the security, transparency, and efficiency of the organ donation and transplantation process. By integrating smart contracts, AI-based matching, and cloud verification, the system automates donor-recipient management and ensures data integrity along with ethical transparency. Experimental results show that LifeServe significantly reduces manual errors, speeds up matching, and builds trust among hospitals and patients, making it a reliable and innovative solution for modern healthcare.

The future potential for this project is vast. Key areas for development include:

1. Integration with National Health Databases: Linking LifeServe with government and hospital networks for seamless data sharing and nationwide organ registry access.

2. AI-Based Predictive Matching: Using artificial intelligence to predict compatibility based on genetic and medical data, improving match accuracy and shortening waiting times.

3. IoT and Real-Time Organ Tracking: Adding IoT sensors to monitor organ condition and location during transport, ensuring timely and safe delivery.

4. Enhanced Privacy Mechanisms: Applying advanced cryptographic techniques like zero-knowledge proofs to protect sensitive medical information.

5. Mobile Application Development: Create a dedicated mobile app for real-time donor registration, status tracking, and instant hospital alerts.

Acknowledgment

We would like to thank our project guide, Prof. S. M. Shelke, for his valuable guidance, constant support, and insightful feedback throughout this research. His expertise, encouragement, and timely suggestions were crucial in shaping and completing this project successfully. We sincerely appreciate his patience, motivation, and continuous supervision, which helped us stay focused and deliver quality work.

We also thank the Department of Computer Engineering at STES's Sinhgad Academy of Engineering, Kondhwa, for providing the necessary resources, technical facilities, and a supportive academic environment that enabled us to conduct this research effectively. The support and cooperation from faculty members and staff significantly contributed to the progress of this project.

7. References

[1] D. Hawashin, G. Alandjani, and A. Al-Asmari, “Blockchain-Based Management for Organ Donation and Transplantation,” IEEE Access, vol. 10, pp. 59013, 59025, 2022.

[2] G. Alandjani, "Blockchain-Based Auditable Medical Transaction Scheme for Organ Transplant Services," International Journal of Advanced Computer Science and Applications, 2019.

[3] L. A. Dajim, F. Alshammari, and H. Alanazi, “Organ Donation Decentralized Application Using Blockchain Technology,” in Proceedings of the International Conference on Computer Applications and Information Security (ICCAIS), 2019.

[4] S. Zouarhi, “Kidner, A Worldwide Decentralized Matching System for Kidney Transplants,” Journal of the International Society for Telemedicine and eHealth, vol. 5, 2017.