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Secure Organ Donation Using Blockchain Technology

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Abstract: *Organ donation is a life-saving process, but the current systems often face issues like delays, lack of transparency, and the risk of fraud. This paper proposes a new system called Secure Organ Chain, which utilizes blockchain technology to enhance the safety, speed, and trustworthiness of organ donation. Blockchain is a secure and transparent digital system that records data in a way that cannot be changed or altered. By using blockchain, this framework ensures that donor and recipient information is protected, the matching process is fair, and all steps are clearly recorded.*

The system also helps hospitals, organ banks, and government agencies work together more efficiently. Our proposed models show how technology can improve trust, security, and coordination in the organ donation process. Blockchain..

Keywords: Blockchain, Organ Donation, Decentralized System, Smart Contracts, Medical Record Management

I. INTRODUCTION

In this Article We introduce Secure Organ Chain, a blockchain-based framework for organ donation and transplantation. This system is designed to connect donors, recipients, hospitals, and authorities in a transparent and trusted environment. Organ transplantation is one of the most critical advancements in modern medicine, offering a second chance at life for patients suffering from organ failure. However, the current organ donation and allocation systems face several challenges, such as a lack of transparency, long waiting times, inefficient matching processes, and the risk of corruption or organ trafficking.

These issues not only delay life-saving procedures but also reduce trust in the system among donors, recipients, and healthcare providers. To address these challenges, there is a growing interest in the security, efficiency, and fairness of the organ donation process. Among these, blockchain technology stands out as a powerful tool for creating decentralized, tamper- proof, and transparent systems.

This paper proposes Secure Organ Chain, a blockchain-based framework designed to enhance the organ donation and transplantation process. By using blockchain, the system ensures secure storage of donor and recipient data, transparent organ matching and allocation, and improved coordination between hospitals, organ banks, and regulatory authorities. Additionally, smart contracts can automate and verify key steps, reducing manual intervention and human error.

The goal of this work is to demonstrate how blockchain can improve trust, traceability, and efficiency in organ donation, ultimately saving more lives through a secure and streamlined process.

II. LITERATURE REVIEW

Sr.No	Title	Authors / Year	Focus Area	Key Contributions
1	Secure Organ Chain: A Blockchain-Based Framework for Organ Donation	Shanmugam et al., 2024	Blockchain DApp for donation	Uses EVM smart contracts and EHR integration to automate and secure organ allocation.
2	Transparency and Trust in Organ	Bharti et al., 2024	Ethical issues, data	Highlights transparency,

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	Donation through Blockchain		immutability	encryption,and stakeholdertrust using blockchain.
3	Designing a Blockchain-Enabled Organ Donation Model	SaiGanesh et al., 2024	Trust and decentralization	Proposes smart contract-based platform for secure, transparent organ tracking.
4	Blockchain-Based Management for Organ Donation and Transplantation	Hawashin et al., 2022	Lifecycle management	Private Ethereum system with six smart contracts for secure and auditable transplants.
5	Predicting Organ Donation Outcomes Using Analytics	Khan & Tutun, 2021	ML-based outcome prediction	Combines ML and network science to predict family consent outcomes.
6	Adoption of Blockchain in Healthcare	Gaynor et al., 2020	Organ transport & EHR	Describes blockchain use in organ transport chain and health data management.

III. PROPOSED METHODOLOGY

The proposed organ donation and transplantation system has been successfully implemented by using blockchain technology. It is built on a private Ethereum blockchain technology, makes it both secure and cost-effective. The system uses smart contracts written in Solidity, a programming language designed for Ethereum. These contracts handle important tasks such as donor registration, patient matching, and allocation in an automatic and transparent way.

The smart contracts were developed and tested using an IDE (Integrated Development Environment). It makes it easy to check for errors and ensure smooth execution. The platform is open-source, meaning anyone can view, modify, or improve the code, which supports transparency and future development. The entire system was also connected to a web-based interface (DApp), making it user-friendly and accessible to doctors, patients, and organizers without needing complex tools.

The use of blockchain in organ donation has shown very positive outcomes. One of the biggest achievements is transparency. Every step of the process, starting from donor registration to the final transplantation, is tracked and recorded permanently. These records cannot be changed or tampered with; the chances of fraud or manipulation are almost eliminated. This creates trust among patients, doctors, hospitals, and authorities.

Another important result is the use of smart contracts, which automate the organ allocation process. These contracts apply clear medical rules, ensuring that organs are distributed fairly and without bias. This prevents confusion, favoritism, or corruption. At the same time, strong encryption and access control keep sensitive information about donors and patients safe from misuse.

The system also provides real-time updates. Doctors, hospitals, and patients can instantly know the status of donations and transplants. This reduces delays, improves communication among all parties, and helps in making quick and effective decisions. As a result, the whole system has become more efficient and life-saving.

The smart contract includes roles for various entities such as doctor, transplant team member, purchasing organizer, and matching organizer. Each one has a unique blockchain address and can only perform specific actions. For example, the procurement organizer deploys the contract, doctors add patients, the medical team confirms tests, and the matching organizer assigns matches. Variables like blood type, organ type, and patient validity are built into the contract to ensure accurate and fair matching. The matching process uses the primary factors such as age, blood type, BMI, and waiting time to select the right recipient.

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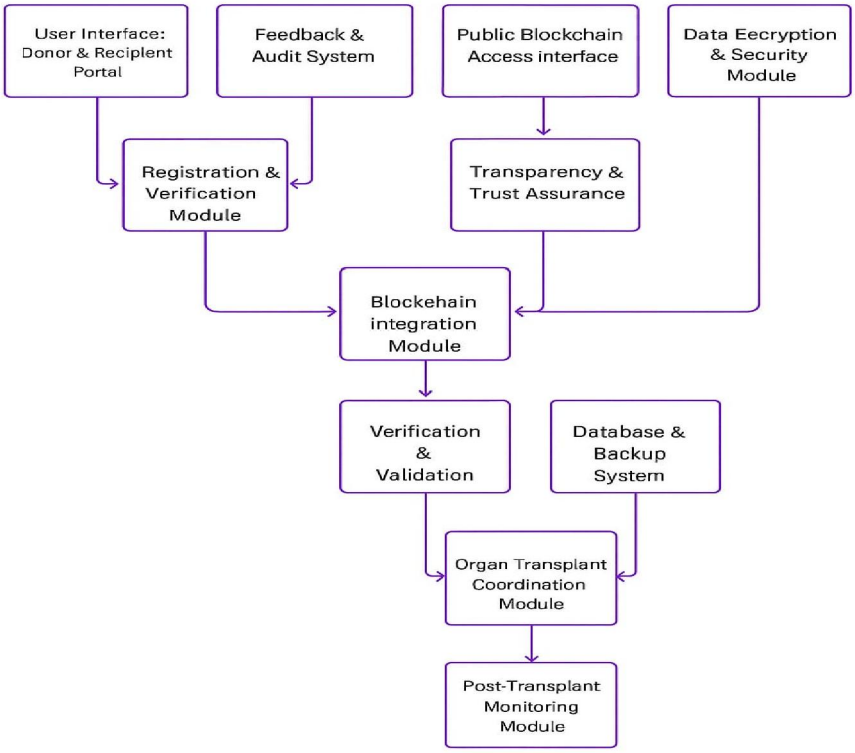

Figure 1: Proposed System Architecture

Overall, the system by Lifesaving Innovations proves that blockchain can improve transparency, trust, and security in organ donation. By creating a permanent and tamper-proof record, the system ensures that every action can be verified. This not only prevents fraud and black-market activity but also gives confidence to both donors and recipients. By following healthcare rules and training staff to use the system properly, blockchain can truly revolutionize the organ donation process.

IV. RESULT AND DISCUSSION

In this section, we looked at how well our solution performs in terms of **privacy, confidentiality, and security.** Normally, Ethereum-based systems have a cost attached to running and executing smart contracts. But in our case, since we used a **privateEthereumblockchain**, we set the gas price to zero. This means our solution does not require any extra financial costs, which makes it more practical and easier to adopt.

When we compare our system with other blockchain-based approaches, we see that our strategy has some clear advantages. The process of organ allocation is very sensitive, as it involves life-and-death situations. Every 12 minutes, a new patient is added to the waiting list, and on average, 21 patients die daily due to the shortage of organs. Different countries have their own rules for allocation, trying to balance fairness and maximize the benefit of transplantation. Our method ensures that the process is**fair, ethical, and transparent** by recording every step on a decentralized system that cannot be altered.

By digitizing records, the system reduces human errors and increases efficiency. Real-time monitoring ensures that all involved parties, patients, doctors, and administrators, have access to the same transparent information. This improves the donor-recipient matching process, increases the chances of successful transplantation, and helps in preventing illegal practices like organ trafficking.

In the comparison, both our solution and one other blockchain-based method used private Ethereum networks. However, many existing solutions did not specify which blockchain they used. Our system also integrates smart

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contracts for automation, traceability, and monitoring, while also being more user-friendly. Unlike systems that require external wallets like Metamask, our solution uses **Ganache test servers** to integrate blockchain with DApps, making it simpler for healthcare staff to use.

Finally, this approach is not limited only to organ donation. The same principles can be applied to other sensitive healthcare and industrial areas, such as **blood donation, medical equipment supply, or even critical product distribution.** This makes our solution flexible and adaptable for future needs.

V. CONCLUSION AND FUTURE SCOPE

In this review article Blockchain technology has a huge potential to revolutionize organ donation and transplantation systems by resolving age-old problems like poor matching of donors and recipients, transparency, hacking of data, and unethical behaviour. Utilization of characteristics like immutability, decentralization, and smart contracts, blockchain facilitates secure, auditable, and equitable organ distribution, improving public confidence and minimizing distribution delay.

Prototypes and pilots provided quicker matching rate, tamper-evident medical records, and automatic ethics compliance.In the future, implementing blockchain in national health registries, AI-matching programs, and interoperable e-health record systems can automate further processes and increase access to transplantation.

Hybrid blockchain architectures will find a balance between privacy and transparency, and power-efficient consensus algorithms will make environmentally friendly adoption possible in medicine.

Creating global blockchain-supported registries and harmonized policies will also make cross-border organ sharing possible, closing disparities and saving more lives

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