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Blockchain-based Management for Organ Donation and Transplantation

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Abstract

Organ donation and transplantation systems now face a variety of requirements and obstacles in terms of registration, donor-recipient matching, organ removal, organ delivery, and transplantation, all of which are hampered by legal, clinical, ethical, and technical restrictions. As a result, a comprehensive organ donation and transplantation system is essential to provide a fair and efficient procedure that improves patient experience and confidence. In this work, we present a private Ethereum blockchain-based system for managing organ donation and transplantation in a completely decentralised, secure, traceable, auditable, private, and trustworthy manner. We create smart contracts and offer six algorithms, along with information on their implementation, testing, and validation. We assess the performance of the suggested solution by conducting privacy, security, and confidentiality assessments and comparing it to current solutions.

Keywords

Privacy, organ donation, transplantation, blockchain.

Introduction

An injury or disease causes organ failure or damage. It reduces one's quality of life and, in rare situations, causes death. Donating an organ is one of humanity's most noble acts in order ɒ save patients' lives through organ transplantation. For a successful transplant, the organ must be in good operating order, with donor-recipient matching, and its removal must not endanger the donor's life. In 1954, a kidney transplant between twin brothers was the first successful organ donation. The yearly number of transplants has continuously climbed since then. However, the demand for organ donations continues to outnumber the number of donors. In reality, twenty individuals die every day while waiting for an organ transplant, and a new patient is born every day.

More crucially, being able to access the organ donor waiting list is a fundamental prerequisite for

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organ allocation. Geographic and socioeconomic considerations can also influence transplant referral. As a result, the waiting list allocation method should not discriminateagainst certain categories of patients. Organ donation can take place in two ways: dead donation and live donation. Figure 1 depicts a typical flow chart for donating and transplanting an organ to a patient. First, the hospital transplant staff examines the donor, and if the donor is deceased, a brain death test is conducted. Meanwhile, if the donor is still alive, physicians evaluate him or her to determine that the donor is healthy enough to donate blood.

The procurement organizer is then notified of all medical records. The procurement organizer is in charge of assessing the donor's health to determine whether he is a suitable donor and ensuring that the donor is appropriately recorded in the medical system. The procurement organizer then provides all of the data to the organ transplantation organizer if the evaluation confirms that the donor is qualified for donation. This stage may only be completed if the donor agrees to donate to an anonymous person. The organ transplantation organizer then performs the matching procedure between available donors and patients on the waiting list.As a consequence, the transplanting surgeons are given a ranked list as an output.

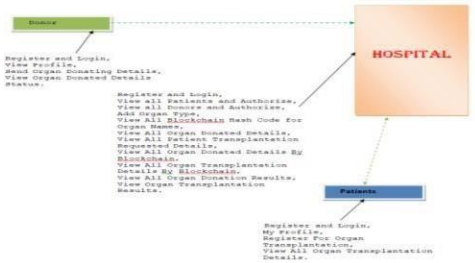

Figure 1. Proposed Architecture

Literature Review

According to L A Dajim proposed that [1] The suggested system is a blockchain-based decentralized software for organ donation. It would be an online application that would allow patients to register their information, including their medical ID, blood type, organ type, and state. Unless a patient is in severe condition, the system would operate on a first-in, first-out basis. A Powell [2] suggested that Organ donation and transplantation systems have unique needs and obstacles in terms of registration, donor-recipient matching, organ removal, organ delivery, and transplantation, all of which are hampered by legal, clinical, ethical, and technicalrestrictions. To improve patient experience and confidence, end-to- end organ donation and transplantation platforms are essential to ensure a fair and efficient procedure. We offer a private Ethereum blockchain-based system for managing organ donation and transplantation in a completely decentralized, secure, traceable, auditable, private, and trustworthy manner. We create smart contracts and three web-based modules for detail validation. We assess the performance of the suggested solution by conducting privacy, security, and confidentiality assessments and

comparing it to the present system. Organ donation,[3] transplantation, Blockchain, Ethereum, and Decentralized are some of the terms used. The procedure of physically taking an organ or tissue from one person (the organ donor) and implanting it into another person (the recipient) is known as organ donation. Transplantation is required when the recipient's organ fails or is damaged due to illness or accident. One of the most significant advancements in contemporary medicine is organ transplantation. Unfortunately, the demand for organ donors outnumbers the number of people who give. Every day, 21 individuals in theUnited States die while waiting for an organ transplant, and over 107,380 men, women, and children await life-saving organ transplants.

Proposed System

This system created a multi-agent software platform to reflect the information pipeline model shared between donor hospitals, regulators, and recipients. This platform optimizes pretrains plantation tasks, potentially increasing process efficiency. Furthermore, it enables the storage of possible donor information and enhances direct contact between all parties in the organ donation process. The built platform was used to mimic an information workflow, and the saved time was estimated to be between three and five hours.

The TransNet in is a system that uses barcode scanning technology at the moment of organ recovery to help label, package, and monitor organs and other biological commodities for transplantation. It entails augmenting the labelling system with a Donor Net-compatible programme and a portable barcode printer. During organ recovery, procurement coordinators will print labels and scan all organs to be delivered using the operating room's system. Similarly, several supply chain management solutions have relied on barcodes, RFID tags, and Electronic Product Codes (EPC) to identify and share product information, allowing things to be tracked through multiple stages.

Related Work

This system provides a private Ethereum blockchain-based solution for managing organ donation and transplantation in a decentralized, secure, reliable, traceable, auditable, and trustworthy manner. The system creates smart contracts that register actors and assure data provenance by establishing events for all of the actions required during the organ donation and transplantation stages. The code for smart contracts is freely available on Github.1 Based on parameters, the system creates an auto-matching process between the donor and the beneficiary via a smart contract. Six algorithms are presented, together with detailed implementation, testing, and validation information. The system does a security analysis to ensure that the suggested solution is safe from common security threats and weaknesses. To demonstrate the originality of our solution, we compare it to current solutions. Our suggested solution is generic and may be simply tailored to fit the requirements of a wide range of related applications. The system is developed an organ donation based on blockchain technology, which is more rapid and safe. The system implemented an automatic procedure of human organ donation in the suggested system.

Conclusions

In this work, we offer a private Ethereum blockchain-based system for managing organ donation and transplantation in a way that is decentralized, responsible, auditable, traceable, secure, and trustworthy. We created smart contracts that automatically record events to assure data provenance. Six algorithms are presented, together with details on their implementation, testing, and validation. We examine the suggested solution's security to ensure that smart contracts are safe from typical attacks and flaws. We compare our solution to other blockchain-based alternatives already on the market. We discuss how our approach may be easily customized to fit the demands of other systems suffering similar issues. In the future, we may improve our solution by creating an end-to-end DApp. Smart contracts may also be implemented and evaluated on a genuine private Ethereum network. Finally, the Quorum platform can provide greater confidentiality because transactions between entities can only beviewed by specific participants and no one else, whereas in our solution, transactions betweentwo participants can be viewed by other actors authorised in the private blockchain.

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