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Management of Organ Donation and Transplantation Using Block Chain

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Abstract

Gift of an organ transplantation systems now face a variety of requirements and obstacles in relation to registration, donor-recipient matching, organ removal, organ delivery, and transplantation, all of which are hampered by legal, clinical, ethical, and technical restrictions. The result is 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 to 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 exchange between identical 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 how many people donated. Actually, twenty people pass away each 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 organ allocation. Geographic and socioeconomic considerations can also influence transplant referral. Due to this, the waiting list allocation method shouldn't treat someone differently 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 organiser is then notified of all medical records. The procurement organiser is in charge of assessing the donor's health to assess if he is a good donor and to make sure that the donor is appropriately recorded in the medical system. The procurement organiser then provides all of the data to the organ transplantation organiser 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 organiser 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.

Literature Review

According to L A Dajim proposed that [1] The suggested system is a blockchain-based decentralised software for organ donation. Patients could register their information for the programme online, 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 technical restrictions. To improve patient experience and confidence, end-to-end donation and transplantation of human organs platforms are essential to ensure a fair and efficient procedure. We offer a private Ethereum blockchain-based system for managing donation and transplantation of human organs a completely decentralised, secure, traceable, auditable, private, and trustworthy manner. We create smart contracts and three web-based modules for detail validation.

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 in favour of organ donors outnumbers the number of persons who give. Every day, 21 People in the US pass away while awaiting organ transplants, and over 107,380 men, women, and children await life-saving organ transplants.

Existing System

The authors in [11] developed a multi-agent software platform to represent the information workflow model among donor hospitals, regulators, and recipient hospitals. This platform optimizes the pre-transplantation tasks, which can improve the process efficiency. In addition, it allows storing potential donor information and improves direct communication among all participants in the organ transplantation process. An information workflow was simulated using the developed platform, and it was estimated that the saved time might be between three to five hours.

Finally, the authors in [9] proposed a manageable mechanism, MIN, for the online matching of deceased organs to donors to improve efficiency and fairness in selecting patients within the current system in Australia. The MIN mechanism simply designates an arriving organ to a patient that minimizes $|KDPI - EPTS|$, tie-breaking by time on the waiting list and later randomly. The Kidney Donor Patient Index (KDPI) estimates the quality of the organ. On the other hand, the

Expected Post-Transplant Survival Score (EPTS) measures the life quality of the recipient after the transplant. After testing, the results showed that the MIN mechanism outperforms the current mechanism under consideration by the Organ and Tissue Authority in Australia.

Proposed System

In recent years, blockchain technology has attracted much attention in different sectors because it offers a distributed and secure database without the need for a third party or a central authority. A significant portion of its development is focused on information architecture, or how the database will be formed, distributed, and accessed with various degrees of permissions [12]. Nakamoto creates the first blockchain, which serves as the public ledger for bitcoin transactions. However, the purpose of blockchain is to enable the recording and distribution of digital data without the ability to modify it. In this sense, a blockchain serves as the foundation for immutable ledgers that cannot be changed or destroyed. By using blockchain, medical information may be stored securely, and patient data could be updated in real-time and across various entities [10]. Managing organ donation and transplantation has become challenging due to the lack of data accountability, immutability, audit, transparency, traceability, and trust features in the existing systems.

Here propose a private Ethereum blockchain-based solution that ensures organ donation and transplantation management in a manner that is decentralized, secure, reliable, traceable, auditable, and trustworthy. We develop smart contracts that register actors and ensure data provenance through producing events for all the necessary actions that occur during the organ donation and transplantation stages. We develop an auto-matching process between the donor and recipient through a smart contract based on certain criteria. We conduct security analysis to determine that the proposed solution is secure against common security attacks and vulnerabilities. We compare our solution with the existing solutions to show its novelty. Our proposed solution is general and may be easily adjusted to meet the needs of a variety of related applications.

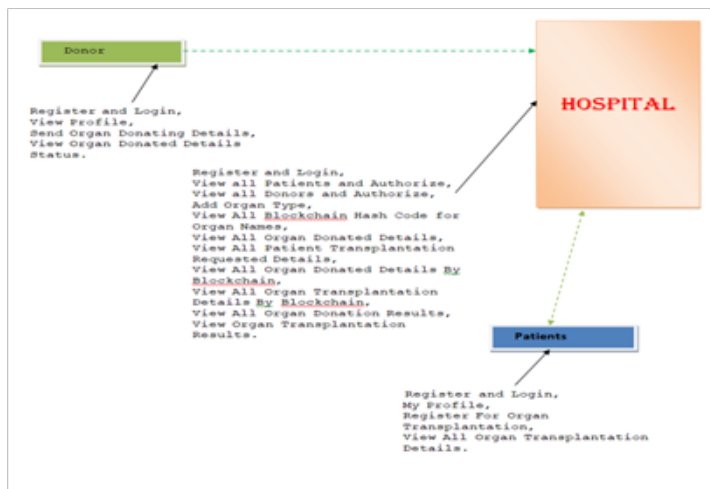


Figure 1 Proposed Architecture

Related Work

The system provides a private Ethereum blockchain-based solution for managing donation and transplantation of organs in a decentralised, 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 particular parameters, the system creates an auto-matching process between the donor and the beneficiary via a smart contract. Six algorithms are presented, 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 is implemented an automatic procedure in terms of organ transplantation the suggested system.

Implementation

Module Description

Donors

The Donor will register and login in this module, then submit their organ donor data to the hospital and do the following operations: View Profile, Send Organ Donating Details, View Organ Donated Details Status.

Patients

Patients connect in to this module using their user name and password. After logging in, the user will do certain actions such as My Profile. Register for an Organ Transplant and View All Organ Transplant Details.

Hospital

The Hospital monitors hospital data to enable organ storage for donation and transplantation, the following operations: View and Authorise all Patients View and Authorise all Donors Include Organ Type, View All Organ Names Blockchain Hash Codes View All Organ Donation Details, View All Patient Transplantation Requested Details, View All Organ Donation Details Using Blockchain View All Blockchain Organ Transplantation Details, View All Organ Donation Results, as well as Organ Transplan

Result

Results show its specific goals and objectives. Here are some general outcomes:

Figure 1 Home Page

Figure 1 shows the home page of organ donation and transplantation

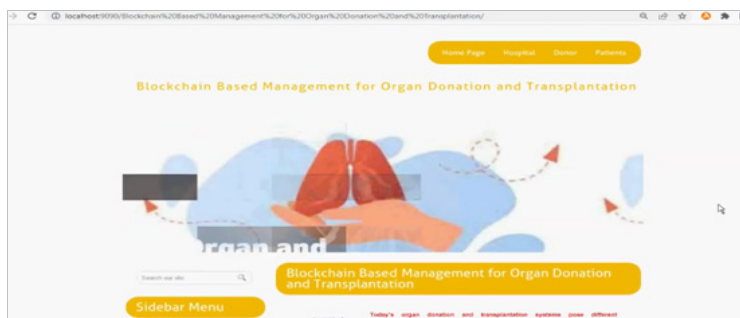


Fig.1 The homepage serves as the main entry point for users and provides essential information and features related to organ donation.

Figure 2 Donor Details List

Fig 2 The donor details list in the context refers to comprehensive record or database containing information about individuals who have expressed their willingness to donate their organs for transplantation.

ID	Name	Email	Password
01	John Doe	john.doe@donor.com	12345678
02	Jane Smith	jane.smith@donor.com	87654321
03	Mike Johnson	mike.johnson@donor.com	11223344
04	Sarah Brown	sarah.brown@donor.com	55667788

Figure 2 Donor Details

Figure 2 Shows the detailed donors list

Conclusions

In this work, we offer a private Ethereum blockchain-based system for managing donation and transplantation of human organs a way that is decentralised, responsible, auditable, traceable, secure, and trustworthy. We created smart contracts that automatically record events to assure data provenance. Six There are provided algorithms along with details on their implementation, testing, and validation. We examine the suggested solution’s security so as to guarantee 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 possible outcomes of our strategy. easily customised 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 be viewed by specific participants and no one else, whereas in our solution, transactions between two participants can be viewed by other actors authorised in the private blockchain.

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