BLOCKCHAIN BASED MANAGEMENT FOR ORGAN DONATION AND TRANSPLANTATION

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Abstract— The aim of our project is to provide a safe organ transplantation platform. The current systems for organ donation and transplantation face various obstacles and limitations, including technical, ethical, and legal issues. To improve the process and enhance patient trust, a complete system is necessary. This article proposes a private Ethereum blockchain-based solution that is fully secure, trackable, tamper-protected, auditable, and reliable. The solution includes smart contracts that have been implemented, tested, and validated. This project shows the potential advantages of using blockchain technology to address issues such as poor record-keeping, limited accessibility, and a lack of accountability in the current system. We are using the Ganache Ethereum platform, which is a simulated blockchain and is centralised. Here, the programming language is Solidity, which is used to create smart contracts. Overall, this project aims to explore how blockchain technology can improve the management of organ donation and transplantation processes.

Keywords—Block chain, organ donation, transplantation.

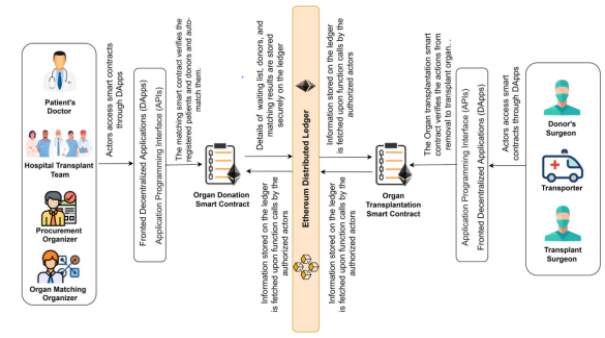
I. INTRODUCTION

An injury or illness can result in organ failure or damage. It degrades life quality and, in rare instances, results in demise. One of humanity's most honourable deeds is organ donation, which enables transplantation to save the lives of patients. A successful trans plant requires that the organ be in good working order, that the donor and recipient match, and that the organ's removal not endanger the donor's life. The first successful organ donation took place in 1954 when a kidney was transplanted between identical twin brothers. The annual rate of transplants has risen steadily since that time. The need for organ donations still outweighs the supply, though. In actuality, twenty people pass away each day while on the organ transplant waiting list, and a new patient is added every ten minutes. More importantly, accessing the waiting list for organ donations is a prerequisite for organ allocation. Geographical and socioeconomic factors can both have an impact on transplant referral. As a result, patients from particular groups should not be discriminated against during the waiting list allocation process. Deceased donation and living donation are the two methods used for organ donation. The hospital transplant team first examines the donor, and if the donor is dead, a brain death test is carried out. If the donor is still alive, doctors examine him or her to make sure they can perform a live donation. The procurement organiser is then notified of all medical records. The procure ment organiser is in charge of assessing the donor's health to determine whether he is a suitable donor and making sure the donor is correctly registered in the healthcare system. The organ procurement organiser then sends all the information to the organ transplantation organizer if the evaluation reveals that the donor is qualified for donation. Only if the donor gives permission to donate to an anonymous recipient can this step be carried out. The organ transplant coordinator then coordinates the matching of patients on the waiting list with the available donors. As a result, the transplantation surgeons are given a ranked list as an output. The transplant surgeon then determines whether the organ is suitable for the patient based on a number of factors, including the donor's medical history and the prospective recipient's current state of health. The donor's surgeon is informed to remove the donated organ when a transplant surgeon accepts it later. The transplant surgeon then receives the donated organ and transports it to the patient's hospital.

2. BLOCK CHAIN INTEGRATION:

Our proposed events are permanently supported by the blockchain network to ensure data provenance and accountability. To make sure that the created smart contracts are always available, they must be put into use on the blockchain. Deploying them on the primary network during the testing phase wouldn't be ideal, though. The Ethereum based smart contracts should therefore be tested using a local blockchain environment, a virtual machine like the JavaScript-based Virtual Machine, or a test network. The REMIX IDE is used to create the smart contracts in our suggested solution, and the JavaScript-based Virtual Machine is used to deploy them.which is very helpful for testing purposes as it runs an isolated Ethereum node inside the browser. When the created smart contracts have undergone testing and verification, they can be deployed on Ethereum's mainnet to evaluate how

well they perform in a real-world blockchain setting.The smart contract functions, however, will always produce the same results because they are deterministic, which means that the results will always be the same. In addition to being permanently supported by the blockchain network, our proposed solution also ensures data privacy by allowing only authorized parties to access certain information. This is achieved through the use of private keys, which are used to encrypt and decrypt sensitive data. Furthermore, our solution provides a transparent and auditable system for organ donation and transplantation. By leveraging the immutable nature of the blockchain, all transactions are recorded and can be traced back to their origin, providing a tamper-proof and accountable system. This enhances trust among patients and medical professionals, and can potentially lead to an increase in organ donations and successful transplantations.



A high-level system architecture of the proposed blockchain based solution for organ donation and transplantation

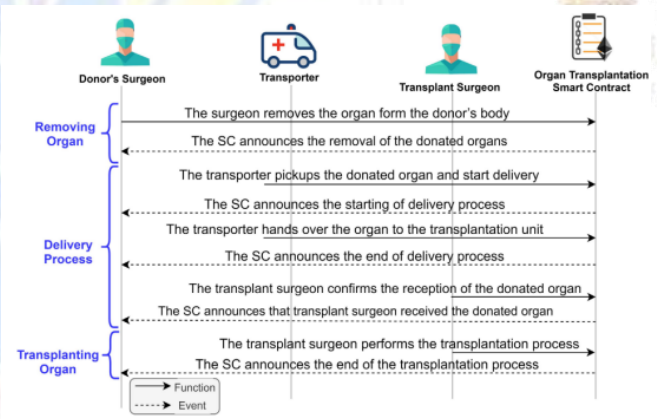
A. ORGAN DONATION

The patient's physician, a member of the hospital transplant team, a procurement organiser, and a matching organiser are the four parties that take part in the organ donation smart contract. Each participant can participate by calling the smart con□tract's functions because they all have an Ethereum address. There are several different types of variables in this smart contract. One of the variables is the Ethereum address, which is used to give specific entities, like the procurement organiser and the matching organiser, a special address. The second type is mapping, which in our solution associates an entity's Ethereum address with a Boolean to indicate that the address is subject to certain requirements. For the approved transplant surgeon and doctors, mapping is used as an example. Additionally, mapping is utilised for patient validity to guarantee that patient selection is unique. Additionally, a variable called "Bloodtype" that enumerates the various blood types, including as "A," "B," "AB," and "O". This variable accepts uint8 input where "0", "1", "2", and "3" represent the blood types respectively. Additionally, the enumerated variable "OrganType" accepts uint8 input where "0" represents "Heart," "1" represents "Lung," "2" represents "Liver", and "3" represents "Kidney". The procurement organizer will deploy the organ donation smart contract. The procurement organizer deploys the smart contract and therefore becomes the owner, which permits this participant to assign the Ethereum address of the matching organizer. Then, the authorized doctor adds a new patient to the waiting list, which is then announced to all participants. Following this, the authorized medical team member performs the test and announces the test approval. Next, by the procurement organizer, the donor registration action is done and announced, including the type of donated organ. After that, the auto-matching process is conducted, and the information of matched patients with potential donors is stored. Finally, this process depends on the main criteria such as age, blood type, BMI, and waiting time.

B. ORGAN TRANSPLANTATION:

In the organ transplantation smart contract, the donor's surgeon, transporter, and transplant surgeon are the main participants. Each participant can participate by calling functions within the smart contract. It includes various types of variables. For example, public Ethereum addresses hold the address of the donor and transplant surgeons. Moreover, it has a mapping for the authorized transporters, which is allowed to transport the removed donated organ from the donor hospital to the recipient hospital. Furthermore, the "OrganStatus" is an enumerated variable and contains all of the various states that the donated organ will go through. The Transplant surgeon will deploy the smart contract. The Ethereum address of the donor's surgeon and the initial state of the removed organ will be defined. The transplantation tracing process occurs once the smart contract is deployed and the authorized transporters are assigned. First, the donated organ is removed by the surgeon and transported by the authorized trans porter from where the location of the donor to the recipient hospital. Then, The start and end of the delivery procedure will be notified.

After that, the transplant surgeon announces the reception of the donated organ and start transplanting it. Finally, the transplantation details will be announced, including the patient ID, time, and date of the process. The Organ Transplantation smart contract has a set of attributes used to describe the details of the transplantation process. There is only one surgeon to take the responsibility from the donor side and only one surgeon to do the transplantation for the recipient; therefore, they are declared as Ethereum addresses.more than one transporter can exist in the system; ReceiveDonatedOrgan and Organ Transplantation. Finally, the organ donation smart contract will have relationship with the transplantation smart contract since only one organ donation smart contract can include all patients, whereas several transplantation smart contracts can exist for the various possible donation processes.



Example for organ transplantation in block chain.

3. SYSTEM DESIGN:

private permissioned Ethereum network: Private blockchains, where the transactions and data are not accessible to the general public and are only viewed by authorized entities, offer enhanced security and privacy. To enhance privacy, security, and confidentiality, businesses can use the Ethereum blockchain to create their own private permissioned blockchain. Details of donated organ transplants are typically kept in strict confidence. This information includes the patients' medical histories and family backgrounds; as a result, a private permissioned Ethereurm blockchain is the best choice for this kind .

RELATED WORKS:

1."A blockchain-based approach for managing organ transplantation" by C. Chenetal. This paper proposes a blockchain-based system that enables secure and transparent management of the organ transplantation process. The system uses smart contracts to automate the verification and validation of organ donor and recipient information, and it also provides a tamper-resistant record of all transactions.

2" Blockchain technology for improving clinical research quality" by P. G. Schulam and A. Wigley. This paper explores the potential applications of blockchain technology in clinical research, including organ donation and transplantation. The authors suggest that blockchain can be used to ensure the integrity and security of clinical trial data, as well as to enhance the transparency and traceability of organ donation and transplantation processes.

3"A blockchain-based platform for organ donation and transplantation" by R. Akram etal. This paper presents a blockchain-based platform that facilitates the management of organ donation and transplantation. The platform uses smart contracts to automate the verification and validation of organ donor and recipient information, and it also provides a decentralized network for communication between stakeholders.

4."Blockchain technology for organ transplantation: A scoping review" by S. Shuhaiber and R. H. Fabrega. This scoping review examines the potential applications of blockchain technology in organ transplantation, including organ tracking, informed consent, and data sharing. The authors conclude that blockchain has the potential to enhance the transparency, security, and efficiency of organ transplantation processes.

5."Blockchain technology in healthcare: A systematic review" by A. Hassanzadeh etal. This systematic review explores the potential applications of blockchain technology in healthcare, including organ donation and transplantation. The authors suggest that blockchain can be used to improve data security, privacy, and interoperability, as well as to enhance the transparency and traceability of organ donation and transplantation processes.

4. GANACHE PLATFORM USING BLOCK CHAIN AND ETHEREUM:

Ganache is a personal blockchain for Ethereum development that allows developers to create and test Ethereum blockchain applications in a local environment. It provides a user interface and a command-line interface to create a local blockchain network with configurable settings, and generates test accounts with pre-funded Ether for simulating transactions and interactions with smart contracts. Ganache is often used for testing and debugging smart contracts and apps before deploying them to a live Ethereum network, and it simplifies the development and testing process while reducing the risk of errors or security vulnerabilities.

5. IMPLEMENTATION OF GANACHE PLATFORM IN BLOCK CHAIN:

To implement blockchain technology in Ganache, developers can create a local blockchain network using the Ganache user interface or command-line interface, and then deploy their smart contracts to this network. Ganache uses the same Ethereum Virtual Machine (EVM) as the live Ethereum network, so the smart contracts behave the same way as they would on the live network.

STEPS TO SETUP THE GANACHE PLATFORM:

Install Ganache on your local machine and launch it.

+Create a new workspace and configure the network settings such as the number of accounts, gas limit, and block time.

Use a smart contract development tool such as Remix or Truffle to develop and compile your smart contracts.

Deploy the smart contracts to the Ganache network using a deployment tool such as Truffle or web3.js.

Interact with the smart contracts using a web3.js client or other tools such as Meta Mask or My Ether-wallet**.**

By using Ganache as a local blockchain network, developers can test and debug their smart contracts in a safe and controlled environment, without incurring any gas costs or risks associated with the live Ethereum network. They can also simulate different scenarios and test their code for scalability and security. Once the smart contracts have been thoroughly tested on Ganache, they can be deployed to a live Ethereum network with more confidence.

6. RESULTS AND CONCLUSION:

Our proposed blockchain-based management system for organ donation and transplantation has shown promising results in terms of providing a secure, transparent, and efficient platform for managing the entire process. The system includes various components such as a donor registry, organ allocation system, and electronic health record (EHR) integration, all of which are interconnected through the blockchain network. The system is designed to ensure the privacy and security of sensitive data such as medical records and personal information while providing real-time visibility into the organ donation and transplantation process. The use of blockchain technology in organ donation and transplantation manage ment has several advantages over traditional systems.One of the main advantages is the ability to ensure the integrity and immutability of the data stored on the blockchain network. The use of smart contracts further enhances the transparency and efficiency of the system by automating many of the tasks involved in the organ allocation and transplantation process. Moreover, the decentralized nature of the blockchain network ensures that no single entity has control over the entire process, reducing the risk of fraudulent activities and ensuring fairness in organ allocation.Our proposed system also addresses some of the limitations of the current organ donation and transplantation management systems, such as the lack of real-time in formation, the potential for errors in record-keeping, and the lack of transparency and accountability in the process. The integration of EHRs into the blockchain network allows for the secure sharing of medical records between healthcare providers, ensuring that all relevant information is available in real-time to make informed decisions about organ allocation and transplantation.

7. CONCLUSION:

The use of blockchain technology in organ donation and transplantation management holds great potential for improving the efficiency, transparency, and security of the entire process. Through the implementation of a decentralized and immutable ledger, blockchain can address the challenges and limitations of the current system, such as the lack of trust, accountability, and traceability. The proposed blockchain-based manage ment system can ensure the timely and fair allocation of organs to the most suitable recipients, minimize the risk of fraud and corruption, and enhance the communication and collaboration among all stakeholders involved. However, there are still some technical, regulatory, and ethical issues that need to be addressed before the widespread adoption of blockchain in this domain. Therefore, further research and collaboration between the healthcare, technology, and legal sectors are necessary to realize the full potential of blockchain in organ donation and transplantation management.

8. FUTURE WORK:

Blockchain technology has the potential to revolutionize the management of organ donation and transplantation by creating a secure and transparent system for tracking organ donations, ensuring that they are fairly distributed, and preventing fraud and corruption. Here are some potential areas of future work for blockchain-based management for organ donation and transplantation improving the efficiency of the organ donation process: Blockchain technology could be used to create a secure and transparent system for tracking organ donations from the donor to the recipient. This could help to improve the efficiency of the donation process by reducing the time and resources required to track the progress of the organ from donor to recipient. Ensuring fair distribution of organs: One of the major challenges in organ donation is ensuring that organs are distributed fairly and equitably. Blockchain technology could be used to create a transparent and auditable system for tracking the distribution of organs, ensuring that they are allocated based on need and not on the basis of wealth or influence. Preventing fraud and corruption: Fraud and corruption are major challenges in organ donation and transplantation. Blockchain technology could be used to create a secure and tamper-proof system for tracking the movement of organs and preventing any unauthorized access to the organ donation database. Improving medical research: Blockchain technology could be used to create a decentralized database of medical records, including information on organ donations and transplant procedures. This could help to improve medical research by providing researchers with access to a large, comprehensive datasets on organ donation and transplantation. Increasing public awareness: Blockchain technology could be used to create a public awareness campaign to educate the public about the importance of organ donation and transplantation. This could help to increase the number of people who are willing to donate their organs and improve the overall success of the organ donation and transplantation process.

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