Management Of Organ Donation Using Dapp In Blockchain

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***Abstract*—the management of organ donation and transplantation systems poses differentchallenges in terms of donor-recipient matching, organ removal, organ delivery, and transplantation withtechnical constraints. Organ donation and transplantation is a complex process that involves multiple stakeholders and sensitive data. Blockchain technology offers a promising solution to address the challenges in this domain, such as data privacy, security, and trust. In this project, we propose a private Ethereum blockchain-based platform for organ donation and transplantation that can facilitate the secure and transparent sharing of data between different parties using DAPP (Decentralized Application). DAPPs use smart contracts, which are self-executing programs that automatically enforce the terms of an agreement between parties. Smart contracts are executed on a decentralized blockchain network, which provides a high level of security and transparency.**

***Keywords*— DAPPs, Private Ethereum, Blockchain Technology, Smart Contracts, Data Privacy, Security.**

I. INTRODUCTION

Organ donation and transplantation is a critical area of healthcare that saves countless lives each year. However, the process of organ donation and transplantation is complex, involving multiple stakeholders, including donors, recipients, hospitals, and regulatory bodies. The process also involves sensitive data, such as medical histories and personal information, which needs to be protected and shared securely.

Block chain technology offers a decentralized and secure platform for managing organ donation and transplantation systems. By utilizing a Dap on the block chain, organ donors and recipients can be matched more efficiently, reducing waiting times and improving patient outcomes. The transparency and immutability of blockchain technology can also ensure the integrity of the donation and transplantation process, reducing the risk of fraud or abuse. With a Dap on the block chain, patients and healthcare providers can have greater control over the donation and transplantation process, ultimately leading to better health outcomes for those in need. Smart Contract is responsible for creating a waiting list, accepting donors after medical test approval, and auto-matching between the donor and recipient using some algorithms. The Organ Transplantation Smart Contract is mostly in charge of the transplant process. It has three parts: removing an organ from a donor, getting the organ to the recipient, and putting the organ into the recipient. All the previous phases are logged and stored on the ledger for revision and verification purposes. Additionally,the security and privacy of the dataare ensured by utilizing a private permissioned Ethereal block chain.

DAPP stands for Decentralized Application, which is an application that operates on a decentralized network. Unlike traditional applications that are controlled by a single entity, DAPPs are built on decentralized blockchain networks that operate through a consensus mechanism. DAPPs use smart contracts, which are self-executing programs that automatically enforce the terms of an agreement between parties. Smart contracts are executed on a decentralized blockchain network, which provides a high level of security and transparency.

II. LITERATURE REVIEW

[1] Donating organs has revolutionized the health sector. There are a lot of people who are willing to donate organs in living, dead, or even brain-deadconditions. The main issue related to organ donation is the delay in the supply of the organ because of multiple factors and hence a lot of patients in need of an organ do not survive. Its aim at resolving this issue using a blockchain which is a distributed database and can dynamically manage such databases. There will be an implementation of blocks that will store the data entered hence facilitating ease in the process. Using blockchain will also guarantee that no one can falsify any block or even have illegal access to the information making all the transactions very secure.

[2] Organ donation being the noblest deed requires revolutionization. One cannot imagine the urgency and desperation a person feels when his/her loved one needs such an act and they could not locate an appropriate donor. On the other hand, people who wish to donate worry about privacy, security, and authenticity. Here,the Proposed System is a web-based applicationthat uses the FIFO approach to select an organ donor for each genuine patient requiring a transplant and if there is an emergency case then priority is given to that patient. It provides an efficient platform for potential organ donors and those who need the organs to connect. It uses Blockchain as its underlying Technology. Blockchain Technology is as it is known a decentralized and distributed network that stores records that are immutable in cannot be altered once saved.

[3] Donating organ and transplantation systems pose different requirements and challenges in terms of registration, donor-recipient matching, and transplantation with legal, clinical, ethical, and technical constraints. Therefore, an end-to-end organ donation and transplantation system is required to guarantee a fair and efficient process to enhance patient experience and trust. A public Ethereum blockchain-based solution to enable organ donation and transplantation management in a manner that is fully decentralized, secure, traceable, auditable, private, and trustworthy. We develop smart contracts and present six algorithms along with their implementation, testing, and validation details. We evaluate the performance of the proposed solution by performing privacy, security, and confidentiality analyses as well as comparing our solution with the existing solutions.

[4] In non-blockchain-based processes, various approaches and tools are utilized to come up with solutions that enhance organ donation, transplantation management, and the matching process. The authors 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 of potential donor information and improves direct communication among all participants in the organ transplantation process, and recovery, procurement coordinators will use the operating room's system to print labels and scan all organs to be transported. Similarly, many supply chain management solutions have relied on barcodes, RFID tags, and Electronic Product Codes (EPC) for identifying and sharing product information to facilitate the tracking of items through various phases.

III. DATASET DESCRIPTION

Table 1 is a comprehensive overview of the effectiveness and efficiency of the organ donation and transplantation system using a Dapp. Tracking these metrics over time can help to identify areas for improvement and inform future development of the system.

Data Fields	**Description**
Number of registered donors	The total number of individuals registered as organ donors in the Dapp system
Number of registered recipients	The total number of individuals registered as organ recipients in the Dapp system
Demographic breakdown of user	Age, gender, and location of registered donors and recipients
Average time to match donors with recipients	The average time is taken to match a donor with a suitable recipient
Number of failed transplants	The total number of failed organ transplants facilitated by the Dapp system
Security of the system	The level of security provided by the Dapp system, including the use of blockchain technology and cryptography
Technical issues encountered	Any technical issues encountered during the implementation of the Dapp system

Table 1. Data metrics

IV. EXISTING METHODOLOGIES

The existing system for organ donation and transplantation without using a Dapp typically involves a centralized database managed by government or non-profit organizations responsible for organ donation and transplantation.The primary stakeholders in this system include donor families, potential donors, transplant centers, hospitals, government agencies, and non-profit organizations.The key tasks and activities in this system include raising public awareness about organ donation, identifying potential donors, approaching donor families, obtaining consent, assessing the suitability of donated organs, preserving organs, and allocating organs to transplant centers.

Ethical considerations in this system include respecting the autonomy of potential donors and donor families, ensuring informed consent, avoiding conflicts of interest, avoiding coercion, ensuring equitable allocation of organs, and maintaining confidentiality.The legal framework for this system includes laws and regulations governing organ donation and transplantation, including requirements for consent, allocation policies, and criteria for determining brain death.Challenges and limitations of this system include limited awareness and understanding of organ donation, religious and cultural barriers, concerns about medical ethics and privacy, shortages of transplantable organs, and potential errors and fraud in the management of the centralized database.

The organ donation system typically involves several methodologies to ensure that organs are donated and transplanted safely and effectively. Here are some of the methodologies used in the existing organ donation system:

A. *Donation after Brain Death (DBD)*

This methodology involves organ donation from individuals who have suffered irreversible brain damage and are declared brain dead. In this process, the donor's organs are recovered for transplantation before life support is withdrawn.

B. *Donation after Cardiac Death (DCD)*

This methodology involves organ donation from individuals who have suffered cardiac arrest and are unable to be revived. In this process, the donor's organs are recovered for transplantation after the heart has stopped beating.

C. *Living Donation*

This methodology involves the donation of organs or tissues by a living individual, typically a family member or close friend of the recipient. In this process, the donor undergoes medical testing and evaluation to determine their suitability as a donor, and the organ or tissue is surgically removed.

D. *Allocation System*

This methodology involves the distribution of donated organs to individuals in need of a transplant based on several factors, including medical urgency, compatibility, and waiting time. This process is overseen by a national organ allocation system, such as the United Network for Organ Sharing (UNOS) in the United States.

V. PROPOSED METHODOLOGIES

A. *Front-end development*

Front-end development refers to the process of designing and building the user interface (UI) of a website, application, or software program. The front end of a website or application is the part that users interact with directly, such as the layout, design, and functionality of the user interface. Front-end development typically involves working with HTML, CSS, and JavaScript, which are the three primary technologies used to build websites and applications. HTML provides the structure and content of the web page, while CSS is used to style the page and make it visually appealing. JavaScript is used to add interactivity and dynamic behaviour to the page. The process of front-end development usually starts with a design or wireframe, which outlines the layout and functionality of the UI.

B. *Smart contract*

A smart contract is a self-executing contract that is coded on a blockchain. It is a computer program that automatically enforces the terms of an agreement between parties, without the need for intermediaries. Smart contracts are designed to be transparent, secure, and tamper-proof, and can be used to automate a wide range of processes and transactions. They are often built on top of blockchain technology, which provides a high level of security and transparency. Smart contracts can be used to automate a wide range of transactions and processes, including financial transactions, real estate transactions, supply chain management, and more.

They are particularly useful in situations where trust is an issue, as they can be programmed to execute automatically once certain conditions are met. Smart contracts are typically written in a programming language specifically designed for smart contracts, such as Solidity for Ethereum. They are stored on the blockchain, which provides a permanent and transparent record of all transactions. One of the key benefits of smart contracts is that they are decentralized, meaning they are not controlled by any single entity.

C. *Security and privacy - sha – 256*

SHA-256 (Secure Hash Algorithm 256-bit) is a cryptographic hash function that is widely used in blockchain technology and other cryptographic applications. It is a member of the SHA-2 family of hash functions, which are designed to be more secure than earlier SHA-1 hash functions.SHA-256 takes an input message of any length and produces a fixed-length 256-bit output called a hash. The output is a unique digital fingerprint of the input message, which can be used to verify the integrity and authenticity of the data.

SHA-256 is a one-way function, meaning that it is impossible to derive the original input message from the output hash.SHA-256 is used in blockchain technology to secure transactions and maintain the integrity of the blockchain. Each block in the blockchain contains a hash of the previous block, which creates an unbreakable chain of blocks that cannot be altered or tampered with. Any attempt to modify a block in the blockchain would require recalculating the hash of that block and all subsequent blocks in the chain, making it virtually impossible to alter the blockchain without being detected.

D. *Backend Data Storing*

Blockchain technology can be used in the backend storing of data for organ donation and transplantation to provide a secure and transparent way of storing sensitive information. The blockchain can be used to store and manage patients' medical data, including their medical history, blood type, and other relevant information. This can ensure that doctors and medical professionals have access to accurate information when making critical decisions. The blockchain can be used to store information about the availability of organs, as well as match donors with recipients. This can ensure that organs are allocated fairly and efficiently, reducing the chances of fraud or corruption.

Blockchain can be used to track and monitor the movement of organs, from donation to transplantation. This can help ensure that organs are properly handled and transported, reducing the chances of damage or contamination. The blockchain can be used to verify the identities of both donors and recipients, ensuring that only eligible donors are allowed to donate organs, and only eligible recipients receive transplants.

Aspect	**Organ Donation & Transplantation System with DAPP**	**Organ Donation & Transplantation System without DAPP**
Transparency	High	Low
Traceability	High	Low
Security	High	Low
Speed	High	Low
Accessibility	Medium	High
User Control	High	Low
Efficiency	High	Low

Reliability	High	Low
Scalability	High	Low
Cost	Medium	Low

Table 2. Comparison of DAPP Vs Without DAPP

VI. RESULT ANALYSIS

Organ donation management using a Dapp (decentralized application) has the potential to revolutionize the organ donation process. The traditional organ donation process has been criticized for its lack of transparency, security, and efficiency. By utilizing block chain technology, a Dapp can create a secure, transparent, and efficient platform for donors, recipients, and healthcare providers. One of the most significant advantages of a Dapp for organ donation management is increased transparency. All transactions related to organ donation can be recorded on a public ledger, making the process more transparent and accountable.

This increased transparency can help build trust in the organ donation system, ultimately leading to more individuals registering as donors. Another advantage of a Dapp for organ donation management is improved security. By using cryptography, a Dapp can secure transactions and protect sensitive information, such as the medical records of donors and recipients. This can help to prevent fraud and ensure that the organ donation process is fair and equitable.

The system flow of the organ donation process begins with the registration of potential donors. With a Dapp, individuals can register their willingness to donate their organs in a secure and decentralized manner. The Dapp can store their information in a distributed ledger, making it easily accessible to authorized medical professionals and organizations.

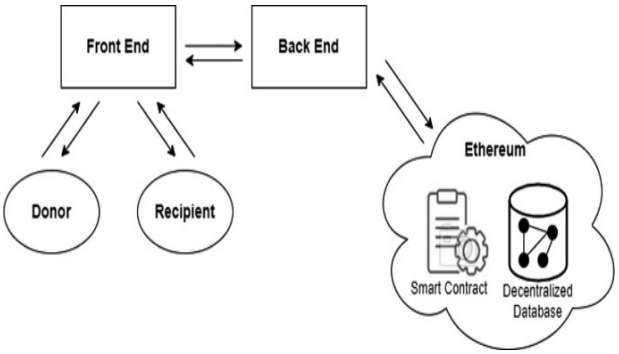

Fig. 1. System Flow

Once an individual has registered, the Dapp can match potential donors with those in need of organs based on a range of factors, including medical history, blood type, and proximity. This matching process can be done automatically, eliminating the need for a manual and time-consuming process. The Dapp can also facilitate the transfer of organs from donors to recipients. When an organ becomes available, the Dapp can notify the recipient and their medical team, while also ensuring that the donor's wishes are respected. The Dapp can also track the organ's movement, ensuring that it arrives at the recipient's hospital safely and securely.

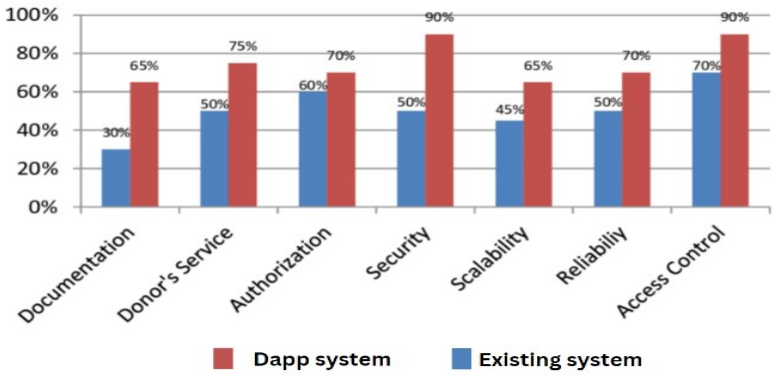

Fig. 2. Comparison chart of the Dapp system

One of the benefits of using a Dapp for the organ donation system is that it can increase transparency and accountability. Because the system is decentralized, no single entity or authority is controlling the process. Instead, all parties involved in the process can view and track the transaction history, ensuring that it is fair and transparent.

Another benefit of using a Dapp for the organ donation system is that it can improve the efficiency of the process. With automated matching and payment processes, the Dapp can significantly reduce the time it takes to find a suitable donor and transplant the organ.

Additionally, a Dapp can streamline the organ donation process by removing intermediaries, reducing administrative costs, and ensuring that donations are matched with the most suitable recipients. The use of algorithms can facilitate faster and more efficient organ matching, increasing the chances of successful transplants. Overall, the use of a Dapp for organ donation management has the potential to transform the organ donation process by making it more secure, transparent, and efficient. This can ultimately increase the number of lives saved through organ donation and improve the quality of life for those in need of organ transplants. While there are challenges to implementing a Dapp for organ donation management, the potential benefits make it a promising area for future research and development.

VII. CONCLUSION

In non-blockchain-based processes, various approaches and tools are utilized to come up with solutions that enhance organ donation, transplantation management, and the matching process. Earlier, they developed a multi-agent software platform to represent the information workflow model among donor hospitals, regulators, and recipient hospitals. In addition, it allows storing of potential donor information and improves direct communication among all participants in the organ transplantation process. In this paper, we have proposed a private blockchain-based solution that manages organ donation and transplantation in a decentralized, accountable, auditable, traceable, secure, and trustworthy manner using DAPPS (Decentralized Application). Developed smart contracts that ensure data provenance by recording events automatically and analysing the security of the proposed solution to guarantee that smart contracts are protected against common attacks and vulnerabilities.

VIII. FUTURE WORKS

In future work, it intends to deploy Blockchain and smart contract solutions to trace the provenance of COVID-19, as this is one of the major issues nowadays, and targets to use of artificial intelligence (AI) based solutions to maximize the probability of success in tracing the origin of COVID-19, and as well other epidemic diseases and also, we implement the smart contracts can be deployed and tested on a real private

Ethereum blockchain network. Finally, the Quorum platform can provide better confidentiality because transactions among entities can only be viewed by specific participants and nobody else, which is not the case in our solution; here transactions between two participants are viewed by other actors authorized in the private block chain.

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