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Using Blockchain Technology to Document Organ Transfers and Deposit Procedures

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ABSTRACT: Challenges in organ donation and systems of transplantation can be posed with respect to registration, matching of donors and recipients, retrieval and delivery of organs, and the actual process of transplantation—all hindered by lawful, medical, moral, and technological barriers. Therefore, the development of a robust donation of and system of transplantation is essential for managing an unbiased and streamlined process to achieve better patient satisfaction and conviction. In this study, a blockchain private ethereum is proposed as a decentralized solution for this purpose. We are going to design programmable contracts and explain six algorithms with testing, operation and validation. Review the results of the system with respect to safety, secrecy, and confidentiality, and compare the same with already existing methods.**.**

I. INTRODUCTION

Injuries or illnesses may make certain organs malfunction or even fail, thus diminishing the quality of life, while others may be fatal. Organ donation is, however, the highest act of humanity to save lives by transplanting organs from one body to another. An organ transplant requires first that the organ be in good working condition, there is a good match between the tissues of the donor and the recipient, and also the process of removal of the organ from the donor should not prove to be life-threatening. 1954 was the year of the first successful organ donation, a kidney transplant between twin brothers. Ever since then, the number of transplants done each year keeps on growing. Nevertheless, demand remains far greater than supply, and every day twenty people die while waiting for a donor organ.

Besides, access to the organ donor waiting list is an important consideration in the allocation of organs. Other aspects that may impact transplant referrals relate to geographical and socioeconomic issues. The method for allocation used in the waiting list should, therefore, ensure that no categories of patients are unfairly discriminated against. There are two types of organ donation: deceased and living donations. Figure 1 illustrates the flowchart of a typical process for donating and transplanting an organ to the patient. First, the transplant team of the hospital examines the donor. If the donor is deceased, then a brain death test is conducted. On the other hand, in case the donor is a living one, doctors check the health of the donor to see if they are healthy enough to donate.

Information on all medical records is then made available to the procurement organizer, who has to appraise the health of the donor and determine his or her eligibility to donate. He ensures the appropriate documentation of the donor's information in the medical system. If the appraisal determines the eligibility of the donor, he then sends all data concerning the donor to the organ transplantation coordinator. This step is done only if the donor has consented to donate anonymously. Afterwards, the coordinator of organ transplantation will match available donors with patients on the transplant waiting lists in order to create a ranked list for the transplant surgeons.

II. LITERATURE SURVEY

[1]L.A. Dajim proposed[1] a blockchain-based decentralized software system for organ donation. This would be an online application in which patients could register their details like medical ID, blood type, organ type, and condition. The system would run mainly based on the first-come, first-served concept, but in cases of critical conditions of the patient, exceptions could be allowed.

[2]A. Powell[2] brought out that donation of and system of transplantation are permeated with a huge number of difficulties and requirements unique to the tasks of registration, matching of donors and recipients, recovery, distribution, and organ transplantations, all complicated by a raft of lawful, healthcare, moral, and technical restrictions. Integrated organ donation and transplantation platforms are important to ensure the process is fair and efficient, enhancing experience of patients and establishing trust. We advocate a blockchain private Ethereum based system for

the management of donation of organ and transplantation in a non centralized, protected, monitored, verifiable, confidential, and reliable way. We implement programmable contracts and three web-based modules for their detailed validation.

EXISTING SYSTEM

The authors of created a multi-agent software platform to reflect the information pipeline model shared between donor hospitals, regulators, and recipients. This platform optimises pre-transplantation activities, possibly enhancing efficiency of process. Furthermore, it enables the storage of possible donor information and enhances direct contact between all parties in the process of donation of organ. The built platform was used to mimic an information workflow, and the saved time was estimated to be between three and five hours.

The barcode scanning technology is already applied in organ recovery within the TransNet system to provide labeling support, package, and monitor the body organ and other specific biological commodities for transplantation. It entails augmenting the labelling system with a DonorNet-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.

PROPOSED SYSTEM

It provides a private blockchain private Ethereum-based solution for the decentralized, secure, dependable, traceable, auditable, and reliable management of transplantation and donation of organ.

It creates smart contracts for the registration of participants and events against all actions involved in the process of transplantation and donation of organ. Following this, it opens the programmable contract code on GitHub. Again, the system makes an automated matching process-between donor and recipient based on certain defined criteria-through a smart contract. It uses six algorithms, after which all details on their deployment, evaluation, and approval are given.

It does the security analysis in order to ascertain that it is secure from any security threats and vulnerabilities which the planned solution may be prone to. We distinguish our resolution with current alternatives in order to distinguish it and show its uniqueness. Our proposed solution is versatile and can easily be fine-tuned in meeting the needs of various related applications.

It is in this process of organ donation in the system that blockchain technology facilitates, making it faster and more secure. The proposed framework integrates an automated process of human organ donation.

Module Description

1. **Donors:** In this module, the donor will register and log in; after that, he will send his organ donation details to the hospital. He will perform the following actions: View Profile, Send Organ Donation Details, and Check Status of Donated Organ Details.
2. **Patients:** This module involves the patients logging in by use of their usernames and passwords. After logging in, they may view their profile, register for an organ transplant, or even obtain the details of all organ transplants.
3. **Hospital:** The information to the hospital, by virtue of facilitating organ storage for donation and transplantation, does all other critical functions. These entail seeing and approving all patients and donors, thereby specifying organ types. It views the names of all organs against their blockchain hash codes. Full information about organ donations and patient requests for transplantation are tracked. It facilitates access to information relating to organ donation through blockchain technology, apart from assessing blockchain records of organ transplantation. Last but not least, the hospital will evaluate all results relating to organ donation and transplantation

III. IMPLEMENTATION
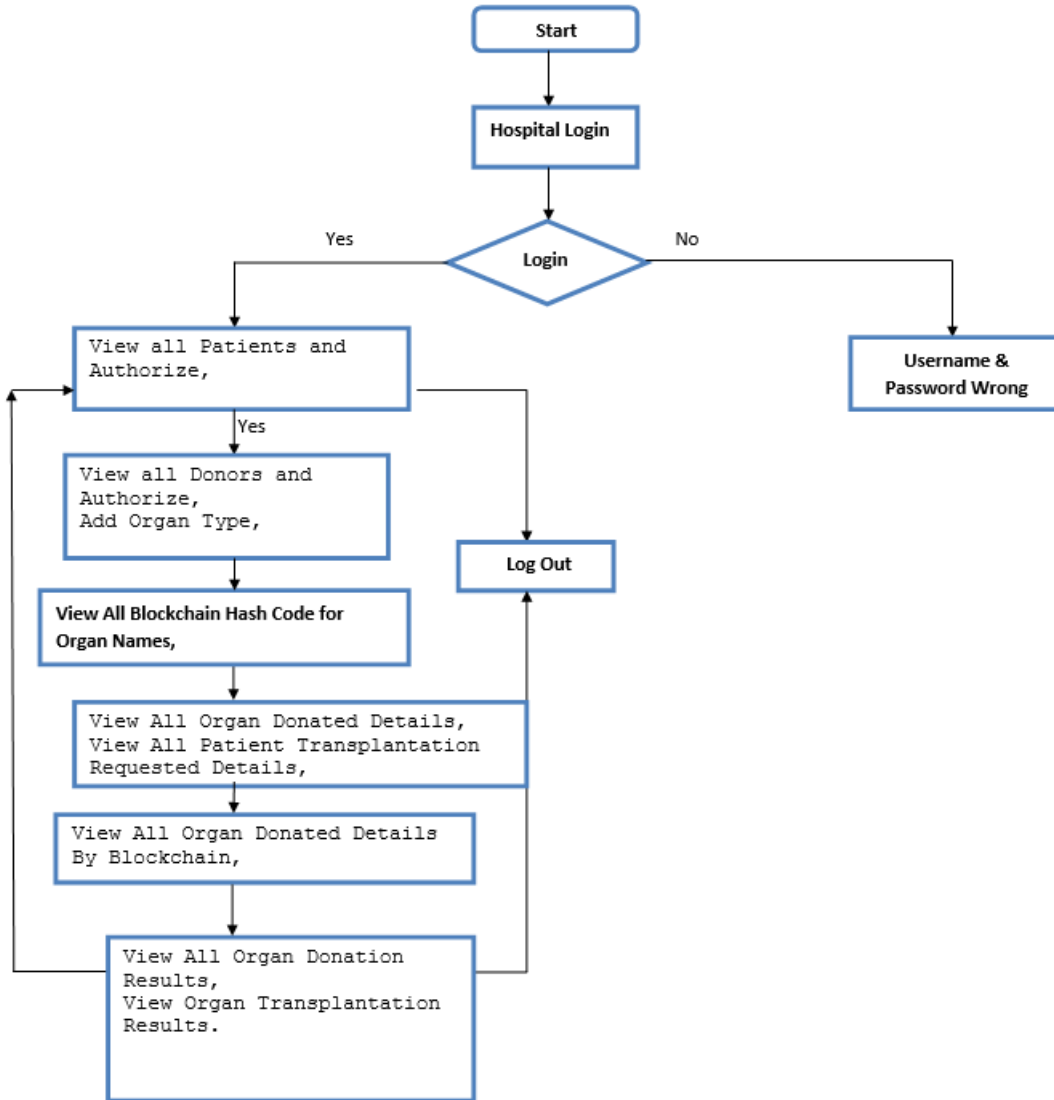
A flowchart for patients in a blockchain-based organ donation system would outline the steps individuals take when participating in or benefiting from the system. Here's an explanation of such a flowchart:

1. **Start**:
    a. This is the initial step where the patient begins their interaction with the organ donation system.
2. **Registration**:
    a. **Register for Donation**: The patient registers their willingness to donate organs through a registration process This entails giving personal information and medical history.
    b. **Registration on Blockchain**: The data of the registration gets recorded securely, ensuring immutability and transparency of recording on a blockchain.
3. **Matching Process**:
    a. **Medical Evaluation**: The data of the registration gets recorded securely, ensuring immutability and transparency of recording on a blockchain
    b. **Matching Algorithm**: Their medical data is matched to some potential recipients concerning needs, which the algorithms use considering factors such as blood type, tissue compatibility, and urgency.
4. **Waitlist**:
    a. If the patient would be a viable donor, then the patient could be placed on a waiting list until an appropriate recipient can be found.

    b. Blockchain Update: Their status on the blockchain is updated to reflect their availability as a donor.

5. **Recipient Matching**:
   a. Once a suitable recipient is found, the patient's data is matched with the recipient's medical requirements.
   b. **Blockchain Transaction**: A transaction recording the match and transfer of organ ownership is validated and added to the blockchain.
6. **Organ Transfer Process**:
   a. **Logistics Coordination**: Coordination begins between hospitals for the physical transfer of the organ from donor to recipient.
   b. **Procedure**: The organ transplant procedure takes place by medical protocols.
7. **End**:
   a. The process concludes once the organ transplant is completed.

Flowchart Symbols Used:
- **Start/End**: Shows the start and end of the process.
- **Process**: Represents actions or steps taken (e.g., registration, matching).
- **Decision**: Points where decisions are made based on conditions (e.g., medical evaluation results).
- **Data Storage**: Represents storage of data, such as on the blockchain.
- **Flow Lines**: Arrows indicating the direction of flow between steps.

IV. CONCLUSIONS

It presents a decentralized, secure system for the management of organ donation and transplantation with a private Ethereum blockchain. We have implemented smart contracts that hold data integrity since all events get recorded on their own. We also elaborate six algorithms with their respective implementations in detail, along with testing and validation. We are more concerned with rigorous security assessments to protect the smart contracts from common vulnerabilities and attacks and make a comparison of our resolution with current blockchain-based alternatives. We would like to mention how far our solution generalizes to handle other similar challenges that other systems face. Some future work in this aspect could include developing a full-fledged DApp for complete end-to-end functionality. Further, in order to provide more confidentiality—for instance, limiting the visibility of transactions only among the two parties involved—a smart contract implemented and evaluated on a real private Ethereum network, such as Quorum, is needed, while our solution now offers this to all authorized actors on the private blockchain.

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