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Blockchain-Based Management for OrganDonation and Transplantation

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Abstract—Nowadays organ donation and transplantation systems causes different requirements and challenges in terms of registration, donor-recipient matching. Therefore, there are peer-to-peer organ donation and transplantation system is required to guarantee a fair and efficient process to enhance patient experience and trust. Here we provide a unique solution based on Ethereum blockchain to manage organ donation and transplantation in a fully decentralized, secure, traceable, auditable, private and trusted manner. We can address the effectiveness of the proposed solution by providing privacy and security.We can solve the performance of the proposed solution by performing privacy, security.

Keywords— Blockchain, Transplantation, Decentralized, Smart Contract, Ethereum, Organ Donation.

I. INTRODUCTION

Failure of organs or the damages they occur may cause disease or injury. It affects the quality of life and, in some cases, leads to death. Organ donation is one of the most honorable acts of humanity to save the lives of patients through organ transplantation. For the better transplant, the organ should be in acceptable working conditions with donor- matching, and removal not pose a life-threatening risk to the donor [1]. The first successful organ donation occurred in 1954 [2] with a kidney transplant between twin brothers. Since then, there has been a steady increase in the annual number of transplants. However, the demand for organ donation still exceeds the number of donors [3]. In fact, while waiting for an organ transplant, twenty people die every day, and a new patient is added to the waiting list in every ten minutes [4]. More importantly, accessing the organ donation waiting list is a basic requirement for organ allocation. Referral for transplantation can be affected by both geographical and socioeconomic factors. Therefore the allocation process on the waiting list should not discriminate against certain groups of patients [5].

II. ORGAN DONATION

Failure of organs or the damages they occur may cause disease or injury. It affects the quality of life and, in some cases, leads to death. Organ donation is one of the most honorable acts of humanity to save the lives of patients through organ transplantation. For a better transplant, the organ should be in acceptable working conditions with donor- matching, and removal do not pose a life-threatening risk to the donor. The first organ donation in the year of 1954 was successful with a kidney transplant between twin brothers.

Since a year number of transplants have increased. However, the demand for organ donations still exceeds the number of donors. In fact, while waiting for an organ transplant, twenty people die every day, and a new patient is added to the waiting list in every ten minutes. More importantly, accessing the organ donation waiting list is a basic requirement for organ allocation. Referral for transplantation can be affected by both geographical and socioeconomic factors. Therefore, the allocation process on the waiting list should not discriminate against certain groups of patients.

III. BLOCKCHAIN

Blockchain is a technology where multiple parties involved in communication can carry out separate transactions without the intervention of third parties. These transactions are verified and verified by a special type of nodes.Bitcoin is the most popular cryptocurrency and an example of a blockchain. Bitcoin is a cryptocurrency and is used to trade digital assets online. Bitcoin uses cryptography proofs instead of third-party trust to allow two parties to transact over the Internet. Each transaction is protected by a digital signature. It's great as a central service to store blockchain data.

Data is transmitted to millions of computers around the world connected to the blockchain. The system allows data on each node to be accessed and publicly verified. A block is a data structure that contains all the necessary metadata about the block (block header) and transaction. In Blockchain the first block is called the genesis block.

- **Distributed Computer-** While managing a distributed immutable ledger, Blockchain is one of the backbone of the main use cases of distributed computing. Distributed computing ensures that each node in the network.
- **P2P Network-** A peer-to-peer network is essentially managed by a host of users who are linked together through a distributed network. On the other hand, it shares the files and documents stored on their computer systems. This P2P Internet connections are

the most resistant to cyber crime said thanks to their distributed network architecture.

- **Node-**A node is a component of cryptocurrency that frequently for most popular currencies such as bitcoin and doge-coin to function. Nodes determine a block of transactions is valid and reject or accept it.Nodes save and store transaction blocks.
- **Hash Value-** A hash function is a mathematical function that takes an input string of any length and converts it into a fixed-length output string. The fixed-length output is known as a hash value.

BLOCKCHAIN ARCHITECTURE

The architecture of the blockchain is distributed and decentralized network that each of the participant will able to maintain, update and approve their new entries. In short, the entire system is controlled by its participants (anyone with a blockchain network). The participants ensure that the entire database is in order as a result of which data verification and data security become easier.

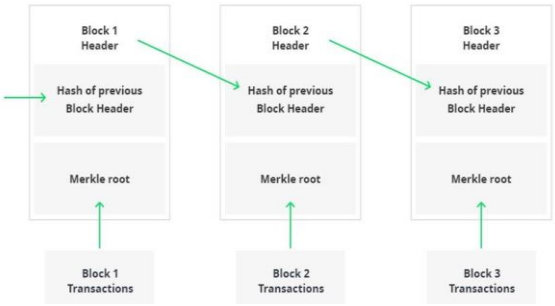

Fig.1. Blockchain Architecture

IV. LITERATURE SURVEY

The survey has been made to study about organ donation and transplantation systems pose different requirements and challenges in terms of registration, donor-recipient matching, organ removal, organ delivery, and transplantation using blockchain. The proposed system focuses on Digital technology to strengthen medical decision-making and provide more transparency.

Organ donation Decentralized application using blockchain technology **[1]** Author: Lama Abdulwahab Dajim; Sara Ahmed Al-Farras; Bushra Safar Al- Shahrani; Atheer Abdullah Al-Zuraib; Rincy Merlin Mathew 2019 - The proposed system is too decentralized the organ donation using blockchain technology. It is one of the web applications that register patients of their information mainly their medical details. It is the process of a first-in, first-out concept where a patient is in critical condition. **[2]** Author : Clemence Niyigena; Soonuk Seol; Artem Lenskiy 2020 A number of allocation algorithms used and some blockchain-based solutions are proposed. The improvement and the coverage for more organ donation patients in need, the organ donation around the world are responsible for the combined efforts. One of the important aspects of such regulations is the fact that the data from stakeholders and the matching patients-donors algorithm is stored in the central point of these organizations. The focus of this paper is on blockchain-based decentralized systems. Partners and applicable patient-donor mechanisms are stored at a central point in these organizations. We also discuss some limitations in existing organ donation systems and allocation algorithms and elaborate on how blockchain technologies could be the cornerstone technology to solve some of the issues in existing are in the area of organ donation. An organ donation management system (ODMS) based on blockchain technology for tracking and security purposes **[3]** Author: Che Akmal Che Yahaya; Ahmad Firdaus; Yong Yew Khen; Che Yahaya Yaakub; Mohd Faizal Abd Razak. 2021 Blockchain is a viable technology for assisting in the deployment of electronic medical records, particularly in terms of data integration and data security. Recent scholarly studies on the use of blockchain for medical record data management have demonstrated that using this technology provides patients with complete control of their medical records. Data should be consistent and correct all the data transmission processors to be clear and perfect. Decentralized data storage is the most appropriate strategy for storing data to expand storage functionality. The element management system currently uses a client-server architecture. As this type of technology stores data on a server, if the server goes down the data is lost and difficult to recover. This study proposes a blockchain-based Organ Donation Management System (ODMS).Organ bank based on blockchain **[4]** Author: Navjeevan Chaudhary; SunilKumar S. Manvi; Nimrita Koul. 2020 The Survey on organ allocation algorithms and blockchain-based systems for organ donation and transplantation Blockchain technology in healthcare: Challenges and opportunities **[5]** Author: Attaran, Mohsen 2022 Current technologies used by the healthcare industry do not adequately address these needs due to limitations related to privacy, security, and interoperability of the entire ecosystem. That the choice justified by one of the most sought after the organ transplants on that of the kidney. This paper identifies the challenges and opportunities for implementing blockchain technology in healthcare and summarizes the key players offering healthcare-related blockchain products and solutions in various applications. So, our research extends and complements existing blockchain research in healthcare. Secured, intelligent blood and organ donation management system- "Lifeshare" **[6]** Author: P.L.Wijiyathilaka; P.H.Pahala Gamage and De Silva, KHB and Athukorala, APPS and Kahandawaarachchi, KADCP and Pulasinghe, KN 2020 To keep track of all registered donors, the proposed system generates a smart token generated by the Ethereum Smart Contract (ESC). Using a linear regression model with a high R-squared accuracy value of 0.998, the computer predicted blood demand for the next ten years. This will reduce blood loss and blood loss. The system will

automatically send questionnaires to registered users to identify and assess awareness and concerns about organ donation. Overall, this study aims at safe and transparent internet usage. Thus, it facilitates an innovative and effective blood donation and organ transplant in Sri Lanka's health care sector.

V. EXISTING SYSTEM

While we are using non-Blockchain-based processes, there are various approaches and tools that are utilized to overcome with solutions that enc enhance organ donation, transplantation management, and the matching process. There are multi-agent software platform to represent the information of their workflow model of donor hospitals, regulators, and recipient hospitals. Recently the scholar studies on the use of blockchain for the medical records and the data management have shown that using this technology gives patients complete control over their medical records. In addition, it allows storing potential donor information and improves direct communication among all participants in the organ transplantation process. One disadvantage is that it can be difficult to co ordinate the entire process. Information being leaked.Time Delay.Lack of communication.

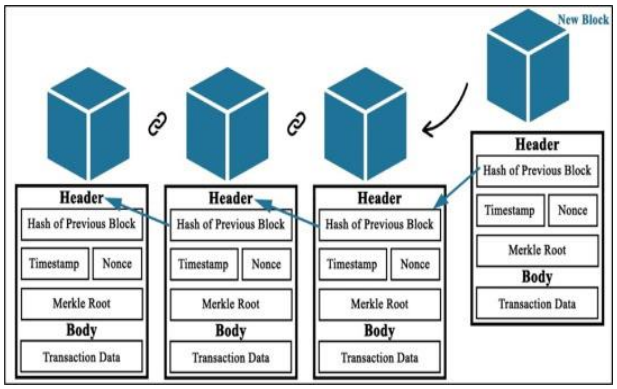

Fig.2. Traceability Framework

VI. PROPOSED SYSTEM

Blockchain-Based Management for Organ Donation and Transplantation Blockchain for Medicine and Healthcare Blockchain-based organ donation and transplantation systems will help ensure accurate and tamper-proof management of records related to organ donation, transplantation, availability of organs, and transplantation outcomes, as well as to track progress and management of organ transplantation. Also, block chain technology should therefore be used for organ donation and transplantation. In this way, organizations can verify donors, recipients, and organ donors, and transplantation outcomes, as well as track progress and management of organ transplantation.

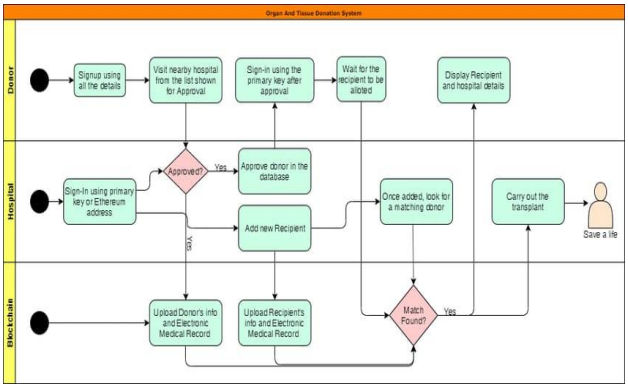

Fig.3. Donation System

Digital technology to strengthen medical decision making and provide more transparency.The block chain-based records are incorruptible.Decentralized data management solutions infuse control in the organization's ecosystem by providing them with the transparency, traceability, and security.With the help of smart contracts, patients can grant or deny access to their own medical records.

VII. SOFTWARE DESCRIPTION

A. Ganache

"Ganache" is a popular tool in the Ethereum blockchain ecosystem used for local blockchain development and testing. It allows developers to create a personal blockchain environment, where they can deploy and test smart contracts without the need for an actual Ethereum network.Ganache provides a local blockchain network that can be customized to simulate a variety of conditions and scenarios, such as testing different gas prices, network speeds, and network congestions. It also provides a user interface that enables developers to inspect the blockchain state, monitor transactions, and debug contracts.In summary, Ganache is a tool that helps developers build and test smart contracts in a local blockchain environment before deploying them to the Ethereum network.

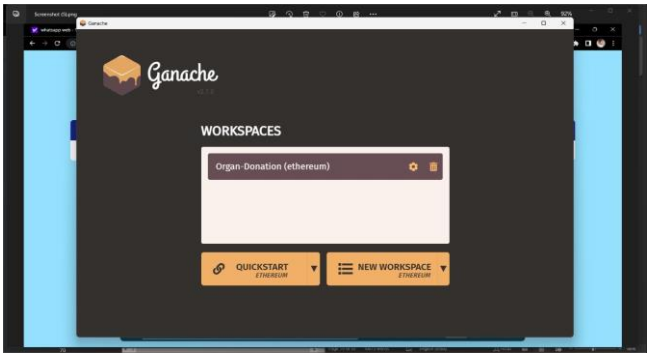

Fig.4. Ganache Workspaces for Organ Donation

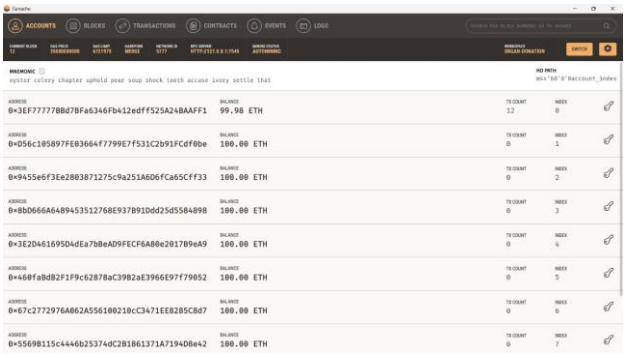

Fig.5. Ganache Address

B. Chain of Blocks

A Blockchain is a chain of blocks connected to each other. A block consists of some parts:

1. Data
2. Hash
3. Previous Hash
4. Timestamp
5. Nonce
6. Merkle tree root

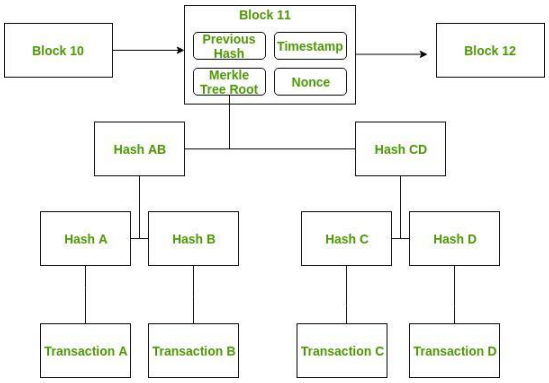

Fig.5. Chain of Blocks

Every block contains a cryptographic value of hash of their previous block's data. The nonce is calculated by miners by solving a cryptographic puzzle to propose the next block in the chain. It is known as a source of employment. The blockchain is said to be immutable because of its cryptographic properties. But this does not mean that it is impossible to change the data. This means that it is extremely difficult to change the data and any changes can be easily detected. Merkle tree is a binary tree with hash pointers.

A tree that contains framework allows the efficient and ecurable verification over the content in a large amount of data is called markle tree. The advantage of using a Merkle tree is that it requires O(long) steps to prove membership. Also, in a sorted Merkle tree, non-membership can be proved in O(logn) steps. The first module is called the Genesis module.

C. Timestamps

Timestamps show that blocks are connected chronologically. It represents the time for each transaction on the blockchain. Securely tracking a document's creation and modification time is an indispensable tool in the business world. This allows interested parties to know beyond doubt that the document in question existed at a specific date and time.By design a bitcoin transaction has a date and time when it is conducted on the blockchain. By adding a cryptographic digest of a file, you can later verify that the data was present at the time. Simply put, timestamps prove when and what happened on the blockchain and are indelible.

D. Markle Tree Value

Each transaction has a hash associated with it. In a block, all transaction hashes in the block are hashed to itself, resulting in a merge root. In other words, Merkle is the hash of all hashes of all transactions in the root block Merkle is included in the route block header. 29 With this scheme, transactions are accepted by the network by returning data with short block headers. This feature is not currently used in bitcoin, but it will be in the future.

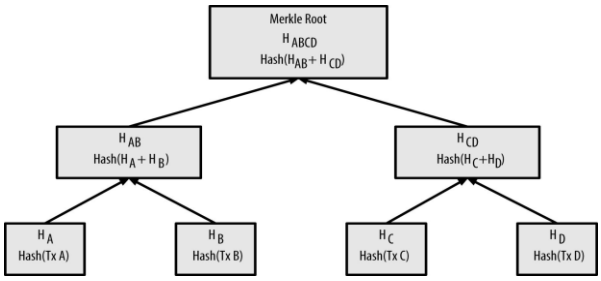

Fig.6. Markle Tree Value

E. Ethereum

Ethereum was created in 2015 by Vitalik Buterin, and since then has become one of the most popular blockchain platforms in the world. Ethereum enables developers to create and deploy smart contracts, which are self-executing agreements written in code that can be used to automate a wide range of financial and non-financial transactions. These smart contracts run on the Ethereum Virtual Machine (EVM),

A decentralized computing platform that executes smart contracts on the Ethereum blockchain. One of the key features of Ethereum is its use of Ether (ETH), a cryptocurrency that is used to pay for transaction fees and as a store of value. Ether is also used as the main currency

in many decentralized applications built on the Ethereum blockchain.

Ethereum has a large and active development community, and there are many tools and frameworks available for developers to build and deploy dApps on the platform. These include development frameworks like Truffle and testing environments like Ganache. Ethereum has been used to build a wide range of decentralized applications, including decentralized exchanges, prediction markets, and games. Its versatility and flexibility make it an attractive platform for developers looking to build innovative new applications in a decentralized and trustless environment.

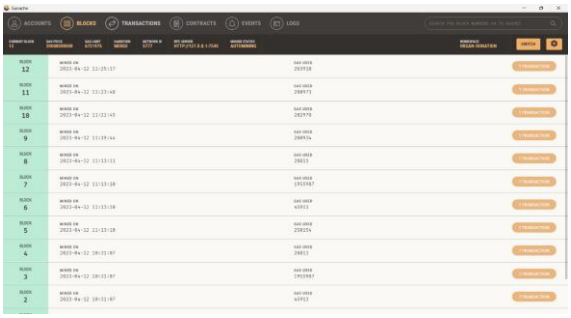

Fig.7. Ethereum Transaction

VIII. DATAFLOW DIAGRAM

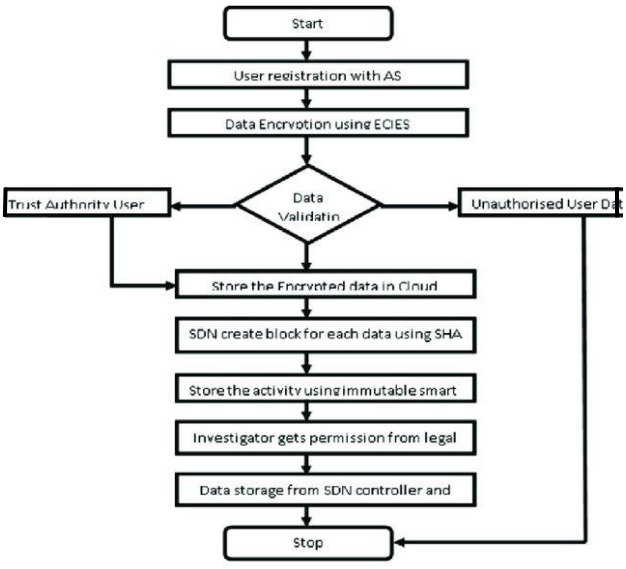

Fig.8. Proposed Architecture on Blockchain

SHA-256 Cryptographic Hash Algo-rithm associated with the blockchain technology and this algo-rithm creates hashes for secure access, mainly used for verifyingdata and message integrity during transaction, session time, dataidentification then password verification. Blockchain technologyis a combination of blocks and hash pointers can be used to builda linked list, which is also called blockchain architecture [4]. Eachblock has a data and a unique hash value of the previous block thenexcept for original block that is contains no previous hashing

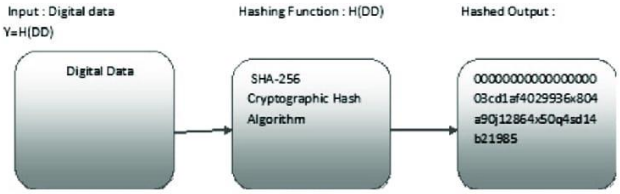

Fig.9. Hashing Function

A certified investigator performs the following procedures: identification, evidence collection, evidence analysis, and report preparation based on a logic diagram of evidence (LGOE) [8,9]. First of all, users are registered and receive their secret keys from Harmony Search Optimization (HSO). Algorithm implementation (SHA-256 cryptographic hash.

IX. RESULT

- The smart contracts can be deployed and tested on a real private Ethereum network.
- 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, where transactions between two participants are viewed by other actors authorized in the private blockchain.

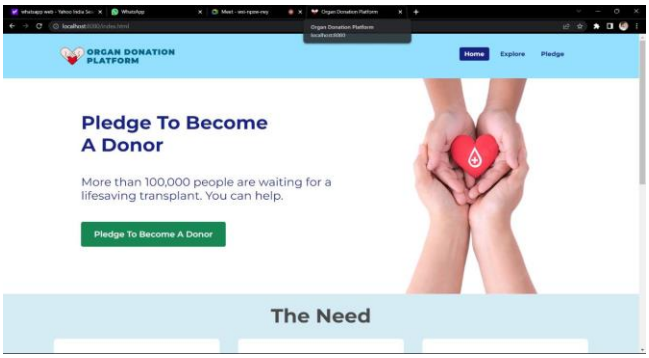

Fig.10. Result

X. CONCLUSION

In conclusion, utilizing blockchain technology in organ donation can have several potential benefits. It can improve transparency, security, and efficiency in the organ donation process, leading to increased trust among stakeholders and better outcomes for patients in need of transplants.

Additionally, it can provide a decentralized platform for tracking and sharing medical records, which can facilitate faster and more accurate decision-making. However, there are also some challenges that need to be addressed, such as ensuring privacy and data protection, integrating blockchain technology with existing systems, and addressing issues of interoperability between different platforms.Overall, while the use of blockchain in organ donation is still in its early stages, it has the potential to revolutionize the field and improve the lives of many people.

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