Securing Organ Donation using Blockchain

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Abstract— Modern systems responsible for the collection, preservation, or transplantation of organs lack transparency. They are slow and are provided with minimum security requirements, resulting in the illegal trade of organs or other serious medical scams. We propose a secure platform to monitor and facilitate the process of organ donation by deploying it on a decentralized platform with the help of blockchain, thus in this process, ensuring security, integrity, and transparency and also eliminating the need for third-party moderators.

Index Terms— Blockchain, Decentralized and Distributed Access, Secure Organ Donation.

1 Introduction

DONATING organs have revolutionized the health sector. There are a lot of people who are willing to donate organs in living, dead or even in brain dead condition.
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 don't survive. We aim at resolving this issue using blockchain which is a distributed database and can dynamically manage such databases. It gives the participant a clear overview of the entire process. 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. Furthermore, to guarantee the physical safety of organs, we also plan on implementing a weight checking system for the container in which the organ will be stored. If any change in weight of the container is recorded by this system, it will automatically be alarmed and the administration will be notified.

The following are the objectives of this project:

1. The biggest objective is to fasten the entire process serially using several blocks.
2. To have a decentralized and distributed access system so that the entire dependency is not on a single node making the process more efficient.

As there also exists a major issue concerning illegal smuggling of organs so using blockchain will reject any illegal access to the system guaranteeing a secure environment for proper functioning.

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2 Literature Survey

The most crucial part of organ donation after it's available is to instantly find a donor and securely transfer it. The introduction of the machine to machine communication where all of these devices communicate without any human interference ensuring fast actions. It includes services that provide convenience to the device owners and along with that conduct certain transactions. They have to maintain track and maintain track of them as well. Already implemented situations use blockchains for tracking all of these transactions without compromising the secrecy of the data of the owner and also to prevent the risk of fraud and also keep its integrity intact for medico-legal requirements.

The health services where e-government applications, Tele-Medicine and Artificial Intelligence have been reviewed. The effects of sharing of the data about patients and diseases among health sector parties through smart contracts have been investigated. Blockchain technology will eliminate inefficiency and will also cause a reduction of costs by conducting transactions among parties without central authority through smart contracts.

Everything could be tied to a blockchain ledger containing verifiable time-stamped records of creation and ownership. These systems could also be used to transfer value between users, detect changes in documents, or prevent data tampering. This has proven to be a very trusted way of transfer entities such as organs via a trustworthy platform. According to NASSCOM, blockchain-led increase in productivity and cost reduction can create a value of up to US$5 billion in the Indian economy by 2023. India has some of the most sophisticated uses of blockchain in some areas. For instance, one of the most advanced applications of blockchain to store property records known to date can be found in AP.

3 Materials And Methods

3.1 Problem Formulation

Modern systems responsible for the collection, preservation, or transplantation of organs lack transparency. They are slow and are provided with minimum security requirements, resulting in the illegal trade of organs or other serious medical

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scams. We propose a secure platform to monitor and facilitate the process of organ donation by deploying it on a decentralized platform with the help of blockchain, thus in this process, ensuring security, integrity, and transparency and also eliminating the need for third-party moderators.

3.2 Proposed Methodology

In this paper, we are proposing a secure method of organ donation over a decentralized platform. This system will be implemented via a web portal that connects organ donors with organ receivers and administered by hospitals. We are trying to completely avoid third-party interference and protecting the integrity of the patient data and identification of the donated organs. This will be attained with the help of smart contracts. Smart contracts will contain the protocols that will govern our organ transaction process and facilitate smooth transactions without intermediaries. These smart contracts will be deployed on a blockchain-based distributed computing platform, Ethereum. All transaction-related information and patient data will be bundled into a smart contract and pushed into the blockchain. We also aim at tracking the location of the organ, during its transfer, with the help of an RFID tag, and continuously monitor its weight to check that the organ container is not being tampered with.

Blockchain is a distributed, decentralized, public ledger. Blockchain technology accounts for the issues of security and trust in several ways. First, new blocks are always stored linearly and chronologically. That is, they are always added to the "end" of the blockchain. After a block has been added to the end of the blockchain, it is very difficult to go back and alter the contents of the block. That's because each block contains its hash, along with the hash of the block before it. Hash codes are created by a math function that turns digital information into a string of numbers and letters. If that information is edited in any way, the hash code changes as well. To change a single block, then, a hacker would need to change every single block after it on the blockchain. Recalculating all those hashes would take an enormous and improbable amount of computing power. In other words, once a block is added to the blockchain it becomes very difficult to edit and impossible to delete.

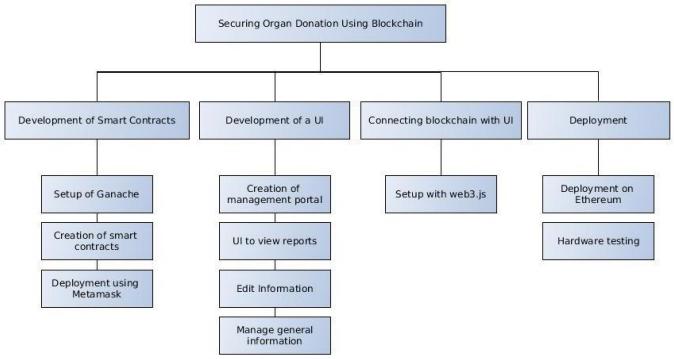

Fig 1: Overview of the proposed methodology

Hyperledger Fabric is a platform for distributed ledger solutions underpinned by a modular architecture delivering high degrees of confidentiality, resilience, flexibility, and scalability. It is designed to support pluggable implementations of different components and accommodate the complexity and intricacies that exist across the economic ecosystem. At the heart of a blockchain network is a distributed ledger that records all the transactions that take place on the network. A blockchain ledger is often described as decentralized because it is replicated across many network participants, each of whom collaborates in its maintenance.

3.3 Block Diagram

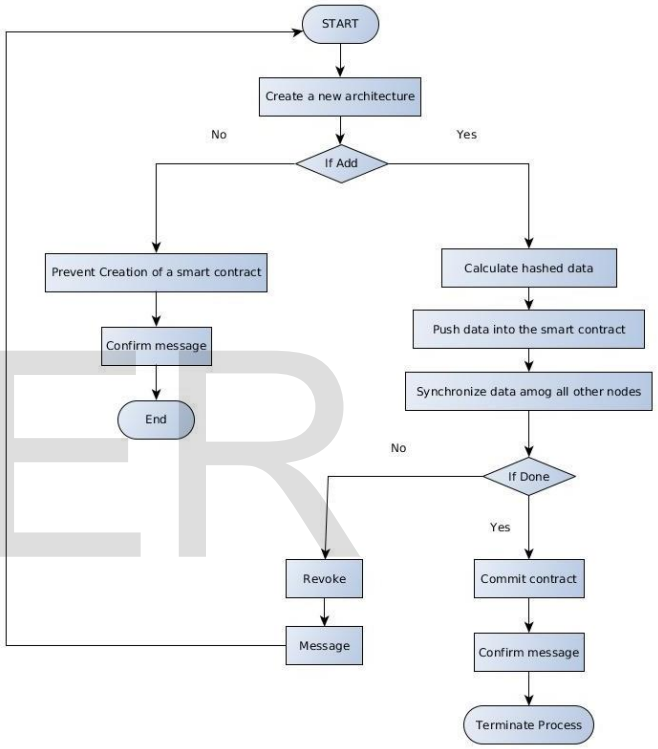

Fig 2: Block diagram of proposed work, split into modules

1. The building of smart contracts with clearly defined protocols to carry out the organ transaction process.
   i. Setup of Ganache and create a private blockchain that runs locally on our terminal.
   ii. Creation of a Solidity smart contract, compilation into JSON, and deployment into a private blockchain.
   iii. Creation and deployment of smart contracts using the Metamask extension of Chrome. Metamask acts both as an Ethereum browser and as a wallet.
2. Development of a user interface to allow a smooth transaction process.
   i. This involves creating a separate management portal to manage data for authorized hospital doctors.
   ii. Develop an interface to facilitate viewing of re-

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ports and matching data.
   iii. Editing information.
   iv. Managing general information about donation centers and patients.
3. Connecting the blockchain with the user interface using a javascript framework web3.js
4. Deploying the blockchain-powered web portal and consequent testing and modifications to be made.

The building of smart contracts with clearly defined protocols to carry out the organ transaction process.
Developing Smart Contracts:

1. Administration
   Manage centers, Manage general Information, Donation center, Manage donation data, View matching report, Search.
2. Donor
   Apply as a donor, Edit contact information, View information about Donation, View map, Check request status.
3. System
   Hashing data, Distributing data, Matching data

3.4 Use Case Diagram and Packages

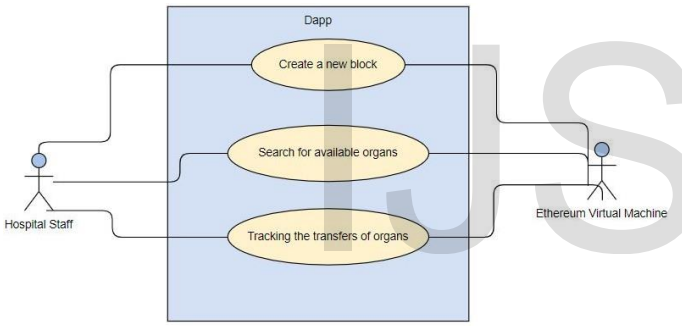

Fig 3: Use case diagram between the hospital staff and Ethereum Virtual Machine

The respective folders within the pre-packed truffle box are as follows:

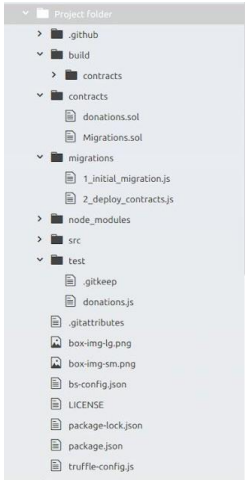

Fig 4: Project Structure and Directory Hierarchy

1. Contracts directory: This is where all smart contacts live. We already have a Migration contract that handles our migrations to the blockchain.
2. Migrations directory: This is where all of the migration files live. These migrations are similar to other web development frameworks that require migrations to change the state of a database. Whenever we deploy smart contracts to the blockchain, we are updating the blockchain's state, and therefore need a migration.
3. node_modules directory: This is the home of all of our Node dependencies.
4. src directory: This is where we'll develop our client-side application.
5. test directory: This is where we'll write our tests for our smart contracts.
6. truffle.js file: This is the main configuration file for our Truffle project
7. Smoke Testing: We will ensure that we've set up our project properly and that we can deploy the contract to the blockchain successfully.

4 Research and Discussion

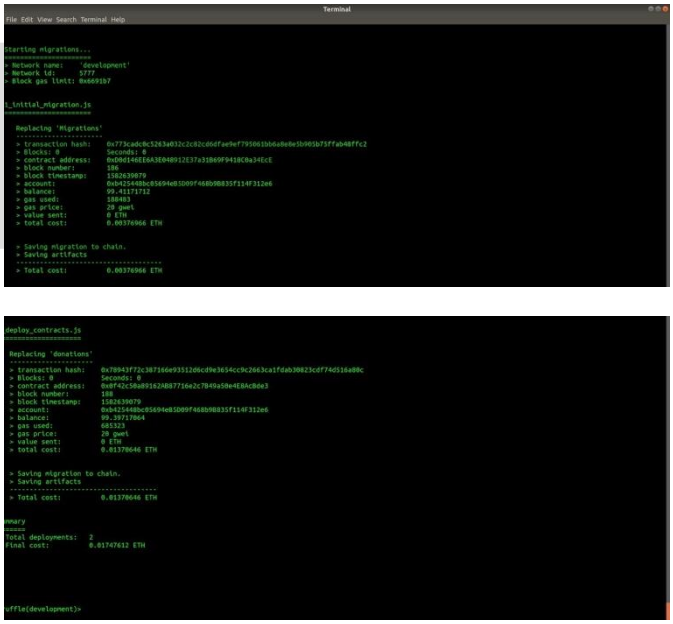

Fig 5: Screenshots of testing and migrating our Blockchain

As soon as the hospital encounters a patient who is probably in a serious condition and the patient as well as their family is willing to donate the organ then they can create a lock for that patient. If the patient dies, his or her organs are made available for a brief amount of time and need to be transferred within that time frame.

Entries like the patient's name, their organ specification, the blood group, and the organ's current status are to be entered and inserted in the chain. Once a record is entered it is im-

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portant to keep a track of the organ and to also get it's latest updates. It is to be transferred within a certain duration otherwise it will not be viable and hence the process needs to be fast as well as secure. Migrations directory is where all of the migration files live. These migrations are similar to other

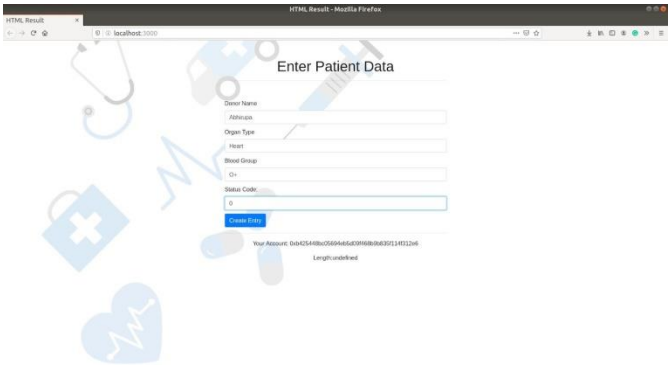

Fig 6: For every new donor the important details are to be filled

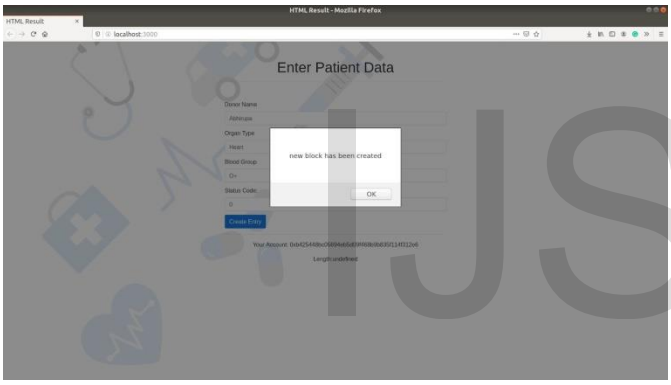

Fig 7: Creation of a new Block

web development frameworks that require migrations to change the state of a database. Whenever we deploy smart contracts to the blockchain, we are updating the blockchain's state, and therefore need a migration.

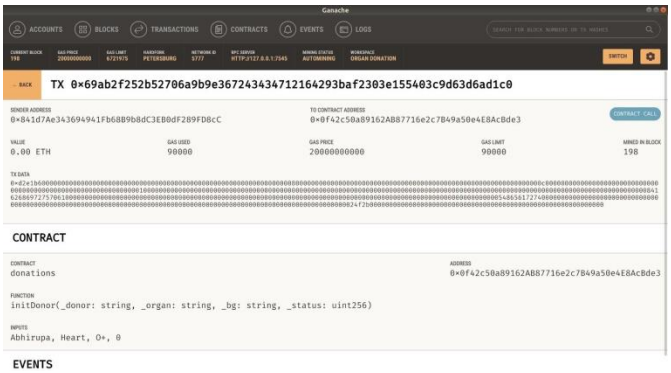

Fig 8: Screenshot of Ganache Workspace

The system needs to be synchronized and the request for any particular organ of the specified blood type is to be catered at the earliest. As soon as a request is put forth the availability is checked and the arrangement for the transfer of the organ is made. Using this organ type that the patient in need is supposed to receive and the specified blood group, the demand is generated. Upon receiving the details of any such donor the hospital will be notified. Thus using this whole mechanism the organ to be donated can reach the recipient at the earliest possible time for successful and secure transplantation.

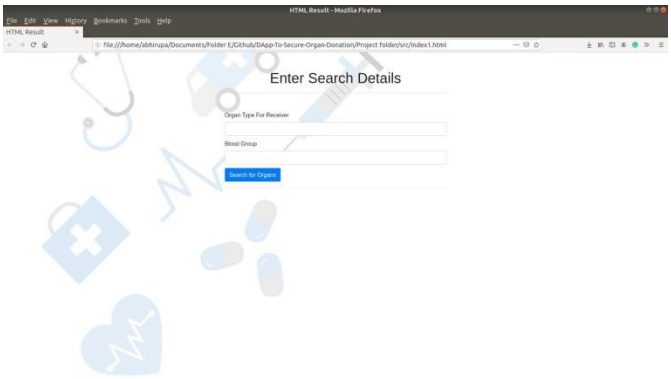

Fig 9: Hospital staff can search entries from this web page

5 Conclusion

As explained in the paper, this whole system explains the importance of the absence of third-party involvement in a process that is so delicate which is also needed to be constantly updated. The usage of a decentralized platform and implementation of blockchain along with smart contracts guarantees both security and synchronization which has been implemented efficiently.

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