BLOCKCHAIN BASED ORGAN DONATION AND TRAFFICKING PREVENTION SYSTEM

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ABSTRACT

This project addresses the critical need for transparency, security, and ethical integrity in organ donation processes, particularly focusing on combating organ trafficking. Leveraging Hyperledger Fabric, our system establishes secure private networks involving hospitals, donors, and recipients, each assigned unique identifiers. Donor and recipient details, including blood groups and organ assets, are meticulously recorded within this system. Utilizing these unique identifiers, we facilitate the seamless matching of compatible organs between donors and recipients, thereby streamlining the transplantation process and minimizing the risk of trafficking. The Hyperledger Fabric framework ensures the utmost confidentiality of these records, safeguarding sensitive information and preserving donor and recipient anonymity. Additionally, the transparent nature of the blockchain technology allows for real-time tracking and auditing of all transactions, providing stakeholders with unparalleled visibility into the organ donation process. From initial donation to post-transplantation, our system tracks every stage of the process, updating the donor registry upon donation and transplant completion. This comprehensive tracking mechanism not only enhances transparency but also serves as a deterrent to illicit organ trade. By maintaining immutable records and enforcing stringent access controls, our initiative aims to instill trust within the medical community and uphold ethical standards in organ procurement. Through the integration of blockchain technology, we empower stakeholders with a reliable and secure platform for organ donation management. Through these concerted efforts, we envision a future where organ donation is characterized by transparency, integrity, and compassion, ultimately saving countless lives and upholding human dignity.

Keyword: - *Blockchain, Hyperledger Fabric, Assets, Participants, Transactions.*

1. INTRODUCTION

Exploring the world of organ donation and transplantation involves many different people, like donors, recipients, doctors, and the government. But there are problems with how things are done now. It's not easy to see what's happening, things take a long time, and sometimes bad things happen, like organs being sold illegally or surgeries being delayed. To fix these problems, we think using something called blockchain could help. Blockchain is a special way of keeping track of things that's safe and doesn't belong to just one person. It could help us keep track of organs from when they're donated to when they're used in surgery. This would make sure the organs are real and safe, and it would make everything faster and cheaper. We could also use blockchain to make sure everyone is doing

things right, like checking if people really want to donate their organs and if they're the right match for someone who needs them. It's like a smart helper that does things automatically, so doctors can focus on helping people. And because blockchain lets everyone see what's happening, it could help us all work together better and make sure everything is fair and clear. In the end, using blockchain for organ donation could make things better for everyone involved, saving lives and making sure people can trust the system.

2.EXISTING METHOD

Blockchain-based management for organ donation and transplantation using Ethereum is an existing method that leverages the decentralized nature of blockchain technology to enhance the transparency, security, and efficiency of the organ donation process. By recording organ donation requests, medical records, and transplantation histories on the Ethereum blockchain, this system enables real-time access to critical information by healthcare professionals, donors, and recipients while ensuring the integrity and immutability of the data. Smart contracts on the Ethereum network can automate various aspects of the donation and transplantation process, such as matching donors with compatible recipients, verifying organ viability, and facilitating financial transactions related to medical expenses and organ procurement. This approach enhances trust among stakeholders, reduces administrative overhead, and ultimately improves the chances of successful organ transplantation, saving lives in the process.

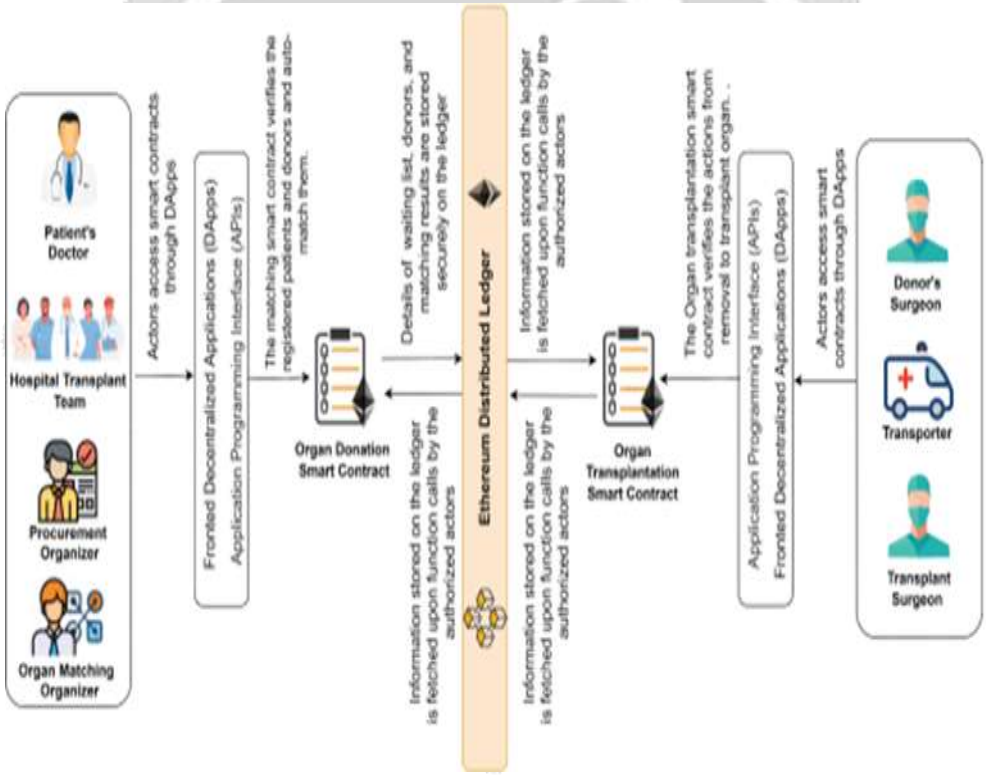

Fig-1: organ donation and transplantation using Ethereum

2.1 Disadvantages of Existing method

The major disadvantages of using Ethereum include scalability issues due to its proof of work consensus mechanism, which can limit transaction throughput and increase latency. Additionally, Ethereum's transparent ledger model compromises privacy and confidentiality, while its decentralized governance structure poses challenges in achieving regulatory compliance and enforcing governance policies. Furthermore, Ethereum's transaction processing times and costs can be variable and high due to its consensus mechanism and gas-based transaction fee model. These limitations hinder the adoption of blockchain solutions for large-scale applications like organ donation and transplantation management.

3. PROPOSED METHOD

The proposed method using Hyperledger Fabric has the following advantages.

3.1 Scalability:

Hyperledger Fabric's modular architecture allows for horizontal scaling, enabling organizations to handle a higher volume of transactions without sacrificing performance. By separating transaction processing into different layers and supporting private channels, Fabric can achieve higher throughput and lower latency compared to Ethereum.

3.2 Privacy and confidentiality:

Hyperledger Fabric implements a permissioned network model, ensuring that sensitive information remains confidential and accessible only to authorized participants. Fabric supports private channels and confidential transactions, enabling organizations to conduct business privately without exposing sensitive data to the entire network.

3.3 Governance and compliance:

Hyperledger Fabric offers a flexible governance model that allows organizations to define membership criteria, establish governance rules, and enforce compliance with regulatory requirements. Fabric's endorsement policies enable organizations to specify the criteria for transaction approval, ensuring that only authorized participants can validate transactions and enforce complex governance rules and compliance standards.

3.4 Performance and efficiency:

Hyperledger Fabric's optimized architecture and consensus mechanisms contribute to better performance and efficiency compared to Ethereum. Fabric uses efficient consensus mechanisms like Practical Byzantine Fault Tolerance (PBFT) or Raft, leading to faster transaction processing times and lower latency. Additionally, Fabric's transaction-based endorsement model reduces computational overhead and resource consumption, resulting in lower transaction costs and improved overall efficiency.

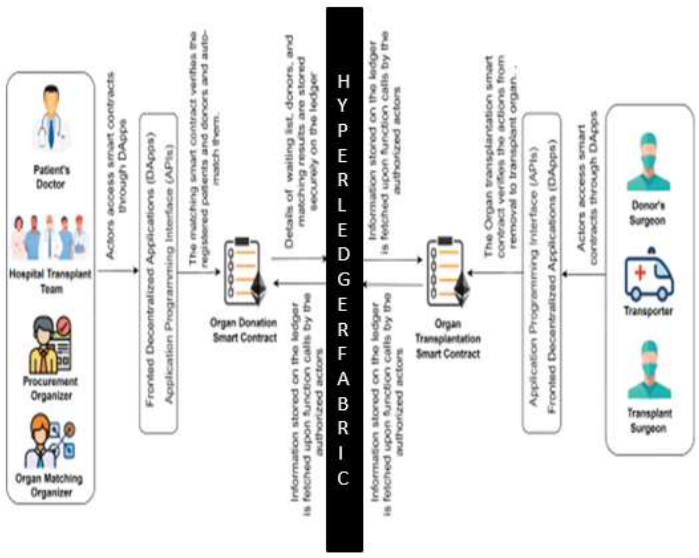

Fig-2: organ donation and trafficking prevention using Hyperledger Fabric

3.5 Trafficking Prevention:

By using blockchain technology, this project can help track and verify the movement of goods and people, making it harder for traffickers to operate. The secure and transparent platform provided by blockchain records ensures that information cannot be tampered with, increasing accountability and reducing the risk of exploitation. This technology empowers law enforcement agencies and organizations to collaborate more effectively in combating trafficking and protecting vulnerable populations.

4. DESIGN METHODOLOGY

4.1 Design Flow

The proposed system's design flow begins with a user interface where donors and recipients interact with the application. This interface connects to the application backend, which manages user interactions and data processing. Upon submission, data undergoes authorization and verification checks to ensure its accuracy and integrity. Subsequently, the validated data is recorded onto the Hyperledger blockchain, leveraging its secure and immutable ledger for transparent and auditable organ donation records. Through smart contracts and consensus mechanisms, the blockchain ensures prevention of organ trafficking by securely managing organ donation transactions and verifying the authenticity of donors and recipients. This holistic approach, from user interface to blockchain integration, establishes a robust system for tracking and safeguarding organ donations, ultimately contributing to the integrity and ethics of the organ transplantation process.

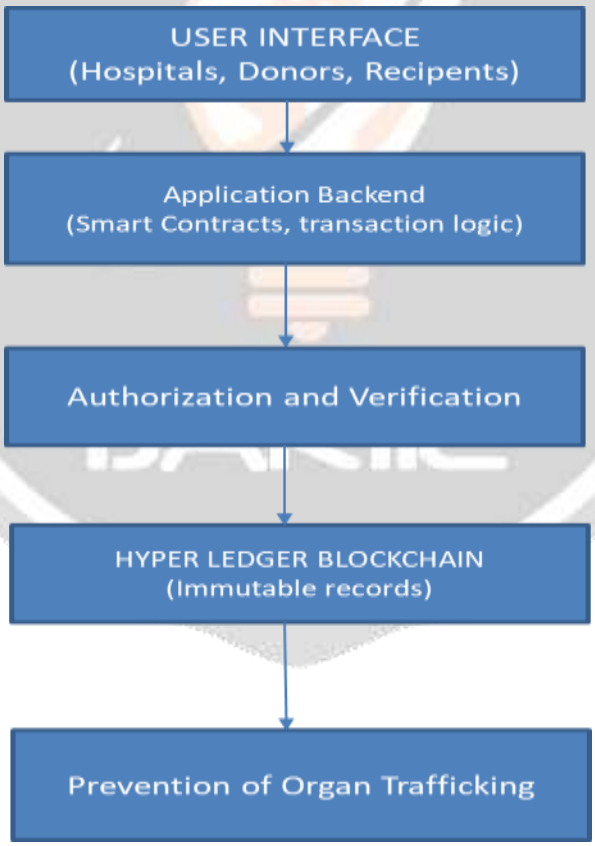

Fig -3: Flow Chart

The project mainly deals with two transactions called as donor organ transaction and transplant organ transaction. The purpose of donor organ transactions is to securely record and track the donation process from the donor's consent to the transplantation. On the other hand, transplant organ transactions serve the purpose of facilitating the allocation and transplantation of organs to recipients in need.

Fig -4: Donor Organ Transaction

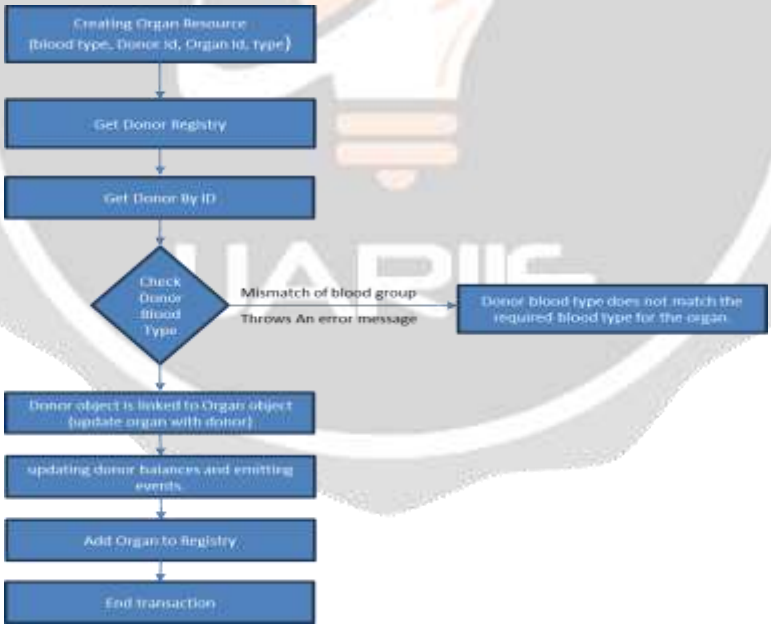

Fig -5: Transplant Organ Transaction

4.2 Steps for Implementation

1. Begin by setting up the necessary blockchain components, including Docker, Docker Compose, and Hyperledger Composer, as per the project requirements.
2. If there is any existing setup, ensure it is destroyed to ensure a fresh start.
3. Launch Hyperledger Fabric to establish the foundation for the blockchain network.
4. Create a PeerAdmin card to manage administrative tasks and permissions within the network.

5. Develop and deploy the business network, defining the rules and logic governing transactions and interactions.
6. Compile the business network into a Business Network Archive File (BNA) for deployment.
7. Install and deploy the BNA file onto the network to make the business network operational.
8. Test the functionality and integrity of the business network using Hyperledger Composer playground.
9. Generate a REST API server to facilitate communication and interaction with the deployed network.
10. Develop an Angular application that interfaces with the REST API, providing users with a user-friendly interface to interact with the blockchain network.

5. Results

Following our trial of the network on Hyperledger Composer playground, a web-based tool for modeling and testing, we found it didn't meet our requirements optimally. To address this, we established a REST API server to enhance interaction with our business network. We utilize HTTP GET and POST methods to submit transactions, and additionally, we developed an Angular application to interface with the REST API. Provided below are screenshots showcasing the transaction statuses.

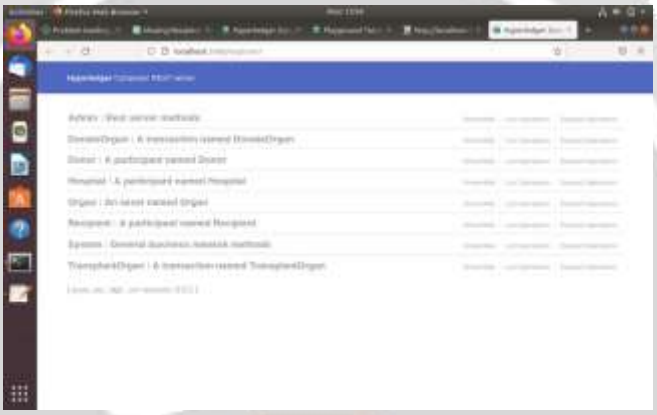

Fig -6: REST Server at localhost 3000

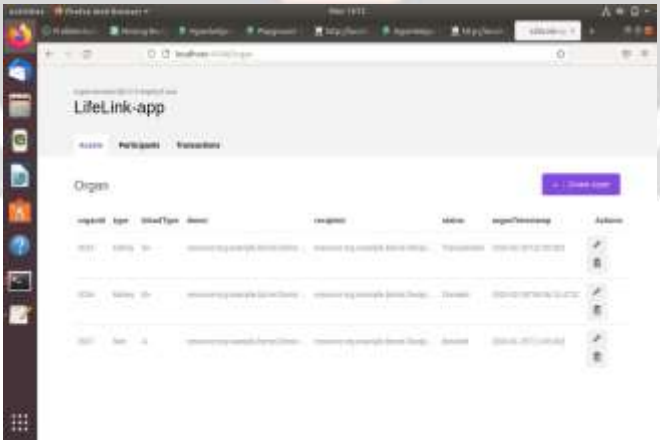

Fig -7: Assets in the business network recipients

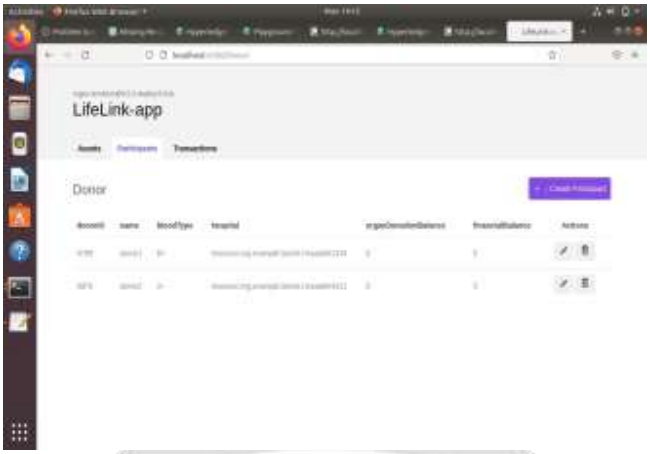

Fig -8: Participants in the business network donors

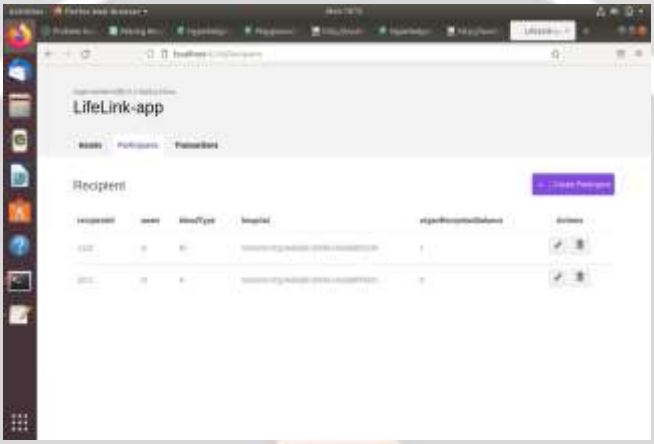

Fig -9: Participants in the business network recipients

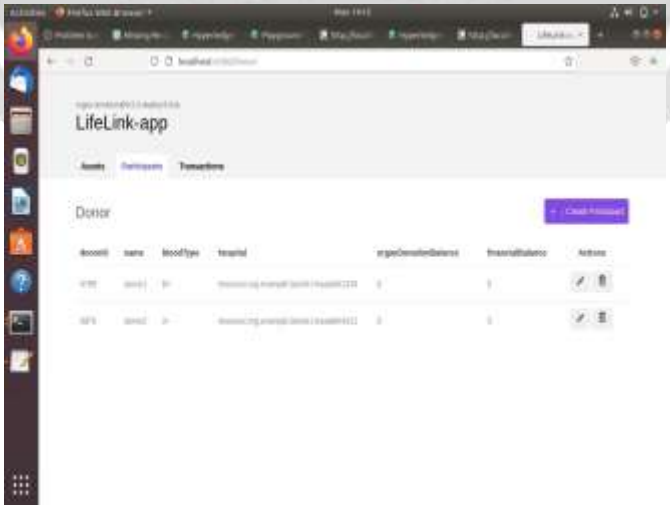

Fig -10: Participants in the business network donors

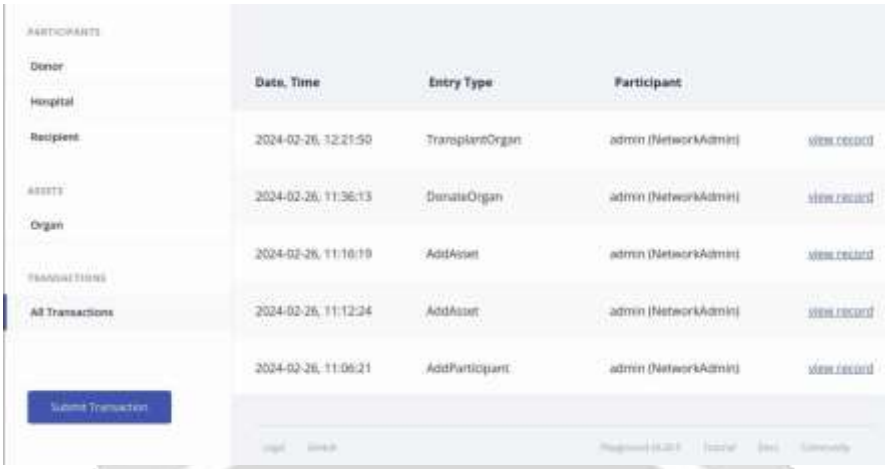

Fig 11: Transactions recorded in the business network organ donation and transplantation

6. Conclusion

We've successfully created a business network model, packaged it as a .bna file, and deployed it onto a local Hyperledger Fabric network. Furthermore, we've established a Composer REST server and an Angular application to communicate with the business network via the REST server, which operates on port 3000. In the future, we intend to deploy the network to the cloud to provide additional security against potential hacker attacks.

7. References

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