

BLOCKCHAIN-BASED LAND RECORDS SYSTEM USING HYPERLEDGER FABRIC

Rishi Nivas Andraju¹, Durgarao Challa², Bala Chandra Darapaneni³, Mohith Kumar Appala⁴

¹⁻⁴Undergraduate Students, Department of ECE, Vasireddy Venkatadri Institute of Technology, Namburu, Guntur, Andhra Pradesh, India

ABSTRACT

In a rapidly evolving digital landscape, the management of land records is a critical aspect of governance, often plagued by inefficiencies, fraudulent activities, and lack of transparency. Our project addresses these challenges by harnessing the power of blockchain technology to revolutionize the way land records are recorded, maintained, and accessed. Our project introduces a novel and secure approach to land record management, utilizing the Hyperledger Composer and Fabric frameworks, which are renowned for their enterprise-grade features and capabilities. Our system brings transparency, security, and efficiency to the often opaque and cumbersome process of land record maintenance.

Keyword: - Blockchain Technology, Land Records, Transparency, Security

1. INTRODUCTION

Hyperledger Fabric is a permissioned blockchain framework designed for enterprise use, offering features such as modular architecture, pluggable consensus protocols, and privacy and confidentiality options. It operates within a network of nodes where each participant maintains a copy of the ledger, ensuring redundancy and resilience. Transactions on Hyperledger Fabric are grouped into blocks and validated by a consensus mechanism agreed upon by network participants, enhancing trust and reliability. Furthermore, Hyperledger Fabric allows for the implementation of smart contracts, enabling the execution of business logic on the blockchain.

The integration of Hyperledger Fabric into the land records system brings additional layers of security and efficiency. By leveraging Hyperledger Fabric, land records can be securely stored and accessed in a decentralized manner, reducing the risk of fraud or unauthorized alterations. Each land transaction or update to records is recorded on the blockchain in an immutable and transparent manner, providing a verifiable history of ownership. Moreover, Hyperledger Fabric's modular architecture allows for the customization of access control rules, ensuring that only authorized parties can modify land records. This not only enhances transparency and security but also streamlines administrative processes, reducing paperwork and errors. Overall, the incorporation of Hyperledger Fabric into the land records system enhances trust, reliability, and efficiency in property transactions.

2. EXISTING LAND RECORD SYSTEMS

Existing land record systems vary widely across different regions and countries, ranging from paper-based systems to centralized digital databases. In some areas, land records are maintained by government agencies or land registries, where documents such as deeds, titles, and surveys are stored and updated manually or digitally. These systems often require extensive paperwork and administrative processes for recording land transactions, updating records, and resolving disputes. In other cases, land records may be managed by private entities or community-based organizations, using a combination of paper documents and digital databases. Regardless of the specific system in place, the primary goal is to establish and maintain accurate records of land ownership, boundaries, and transactions to facilitate property transactions and ensure secure land tenure.

2.1 Disadvantages in existing system

However, existing land record systems are often plagued by numerous challenges and shortcomings. One of the most significant problems is the lack of transparency and accountability, particularly in centralized systems where access to land records may be restricted or controlled by a single entity. This opacity can lead to corruption, fraud, and disputes over land ownership and transactions. Additionally, paper-based systems are prone to errors, loss, and damage, resulting in inaccuracies and inconsistencies in land records. Moreover, the manual and bureaucratic nature of many land record systems can lead to delays, inefficiencies, and high administrative costs, hindering the timely and effective management of land records. Furthermore, the lack of interoperability and standardization among different land record systems can create challenges in data sharing, collaboration, and coordination between government agencies and other stakeholders involved in land management. Overall, these problems undermine the integrity and reliability of land records, posing significant obstacles to secure land tenure and sustainable land management.

3. PROPOSED SYSTEM

Hyperledger Fabric, as a permissioned blockchain framework, provides a transformative solution to address the challenges inherent in existing land record systems. By offering a decentralized, transparent, and immutable ledger, Hyperledger Fabric ensures the integrity and security of land records, thereby reducing the risk of fraud, corruption, and disputes. Each transaction or update to land records is securely recorded on the Hyperledger Fabric blockchain in a tamper-proof manner, establishing a verifiable and auditable trail of ownership history. This transparency enhances trust among stakeholders and promotes accountability in land transactions. Furthermore, Hyperledger Fabric-based land record systems streamline administrative processes, diminish paperwork, and minimize the likelihood of errors or discrepancies, resulting in heightened efficiency and cost savings. Moreover, Hyperledger Fabric's decentralized architecture facilitates seamless data sharing and interoperability among various parties involved in land management, fostering collaboration and coordination. In summary, Hyperledger Fabric offers a robust and reliable framework for modernizing land record systems, ensuring secure land tenure, and enabling sustainable land management practices.

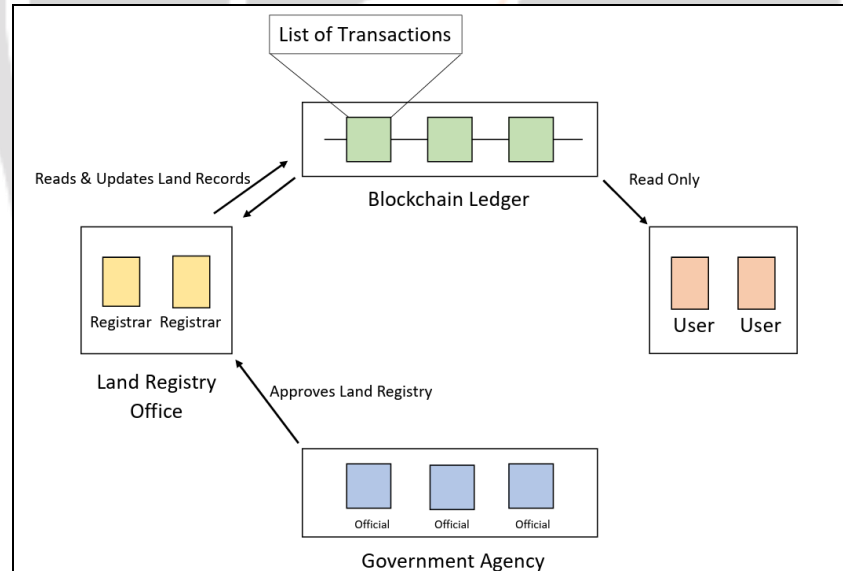


Fig-1: Block Diagram representing the network

3.1 Prerequisites & Environment

- **Docker:** It is a platform that allows developers to package, distribute, and run applications within isolated environments called containers. In the context of building a network using Hyperledger Fabric, Docker is essential because it enables the easy deployment and management of Fabric components such as peers, orderers, and other network entities in separate containers.
- **Node.js:** Node.js is a runtime environment that allows developers to run JavaScript code outside of a web browser, making it particularly suitable for server-side applications. In the context of building a network

using Hyperledger Fabric, Node.js is essential for developing smart contracts and building client applications to interact with the Fabric network.

- **CLI:** Composer-CLI is a command-line tool provided by Hyperledger Composer, a framework for rapidly building blockchain applications on top of Hyperledger Fabric. Composer-CLI is essential for building a network using Hyperledger Fabric as it offers commands for creating, deploying, and managing business networks defined using Composer modeling language.
- **Rest Server:** Composer-REST-Server is a tool provided by Hyperledger Composer that automatically generates a RESTful API for a business network deployed on Hyperledger Fabric. Its necessity in building a network using Hyperledger Fabric lies in its ability to simplify and accelerate the development of client applications that need to interact with the blockchain network.
- **Yeoman:** Yo, short for Yeoman, is a robust scaffolding tool that aids developers in generating project structures and automating repetitive tasks. In the context of building a network using Hyperledger Fabric, Yo is necessary because it serves as the foundation for tools like Generator-Hyperledger-Composer.
- **Generator Hyperledger Composer:** Generator-Hyperledger-Composer is a Yeoman generator that helps developers scaffold Hyperledger Composer project structures, including business networks, participants, assets, transactions, and events. Its necessity in building a network using Hyperledger Fabric stems from its ability to streamline and standardize the initial setup and configuration process.

3.2 Methodology

In the network, we assume two main assets: "land record" and "land parcel." These represent essential information about properties, such as ownership details and transaction history. There are also two participants: the "land registry" and the "government agency." The land registry manages and updates land records, while the government agency oversees land-related activities.

Transactions in the network facilitate interactions. For example:

- The land registry creates new land records when properties are acquired.
- When a property is sold or transferred, the land registry updates the corresponding land record to reflect the change in ownership.
- The government agency monitors the network and may verify or validate land records for regulatory purposes.

Overall, the network enables seamless interactions between participants and assets, ensuring accurate recording and maintenance of land records while promoting transparency and accountability in land-related transactions.

Steps to implement are as follows:

- Install prerequisites for Hyperledger Composer.
- Install environment for the development of the project.
- Download and configure Hyperledger Fabric on the system.
- Create a business network and define the assets (land record, land parcel), participants (land registry, government agency), and transactions (create, update land record).
- Implement access control to restrict modifications to the network to the land registry.
- Start the Hyperledger Fabric Business network.
- Finally, interact with the network using an Angular Web Application.

4. RESULT

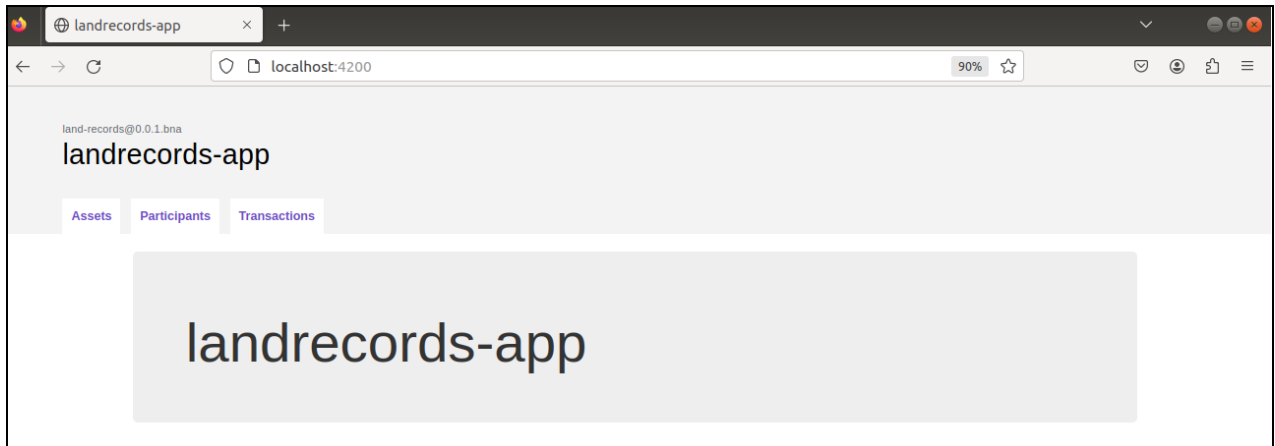


FIG-2: Angular Web Application

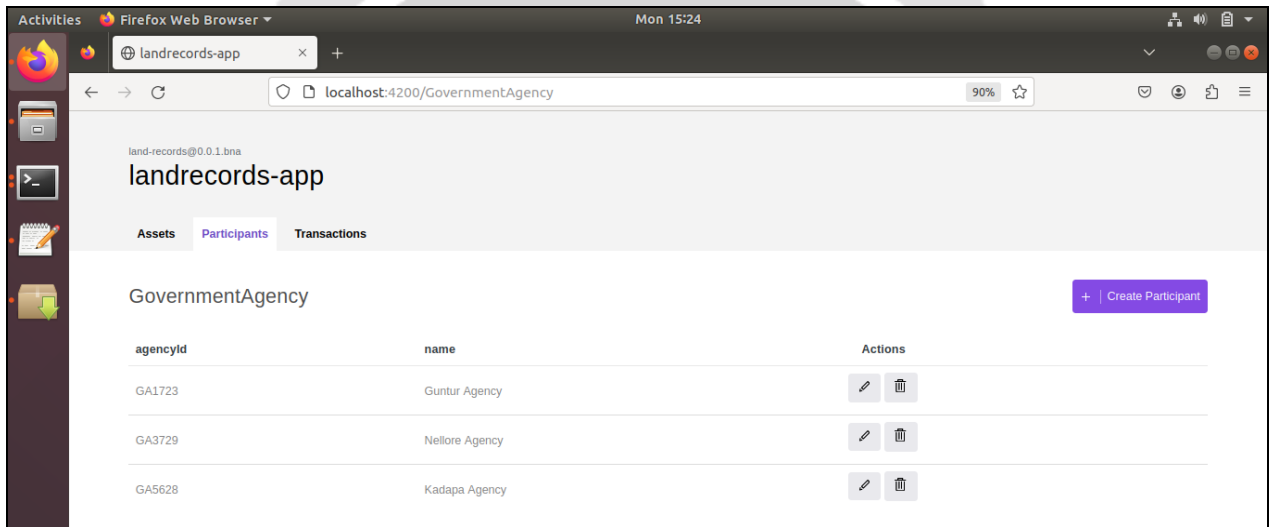


FIG-3: Participants (Government Agencies)

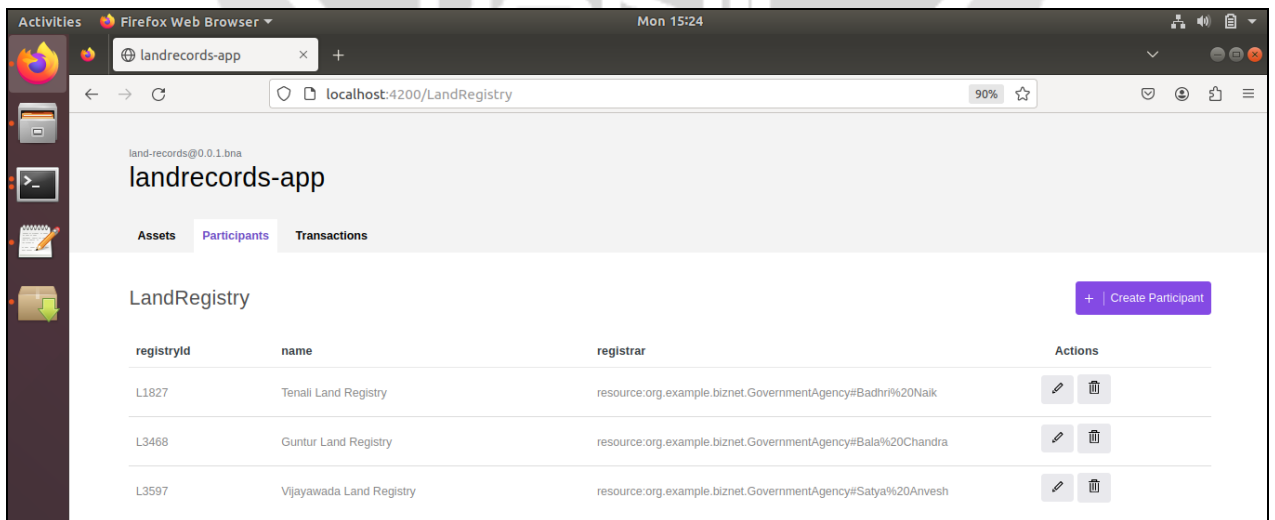


FIG-4: Participants (Land Registries)

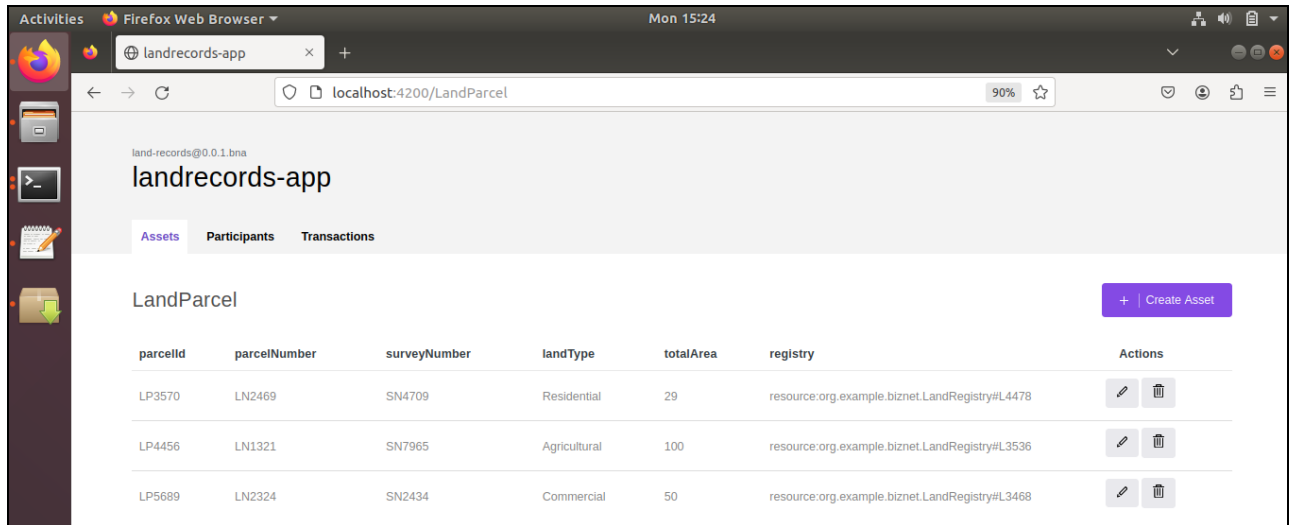


FIG-5: Assets (Land Parcels)

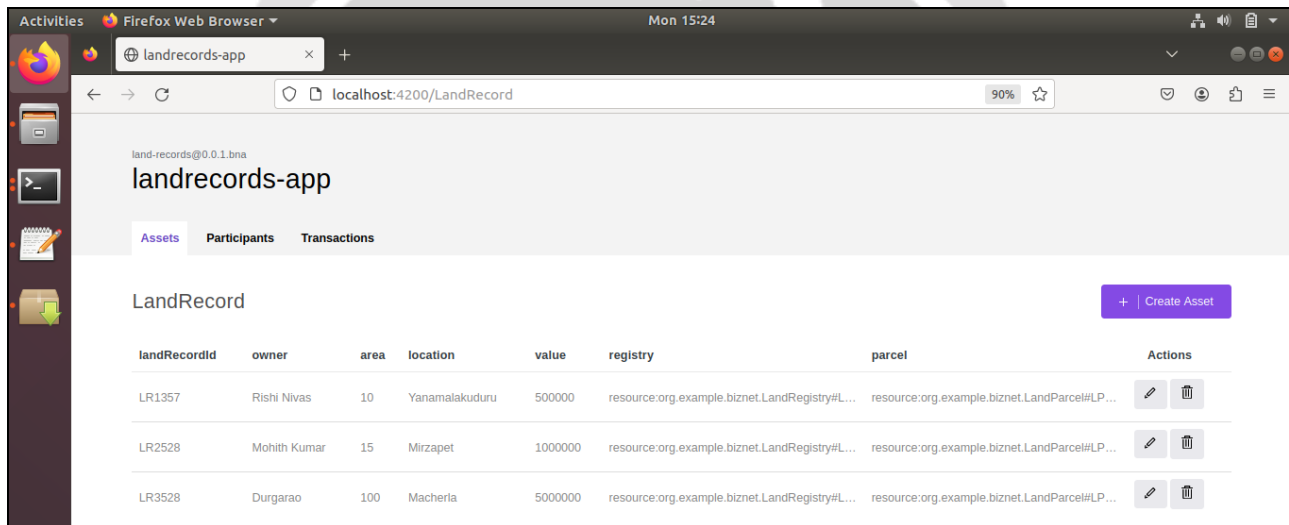


FIG-6: Assets (Land Records)

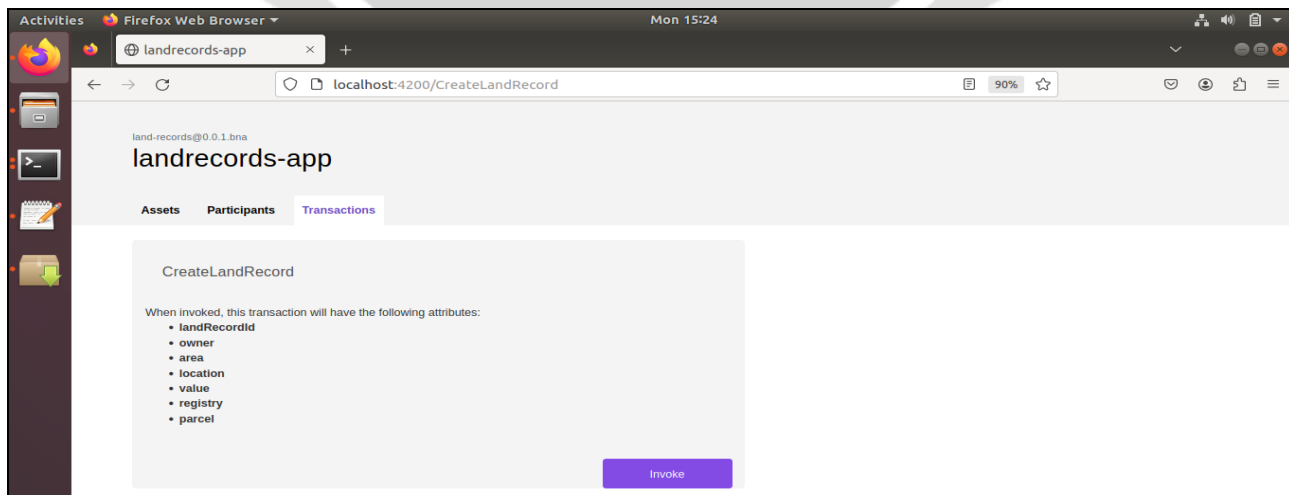


FIG-7: Transactions (Create Land Record)

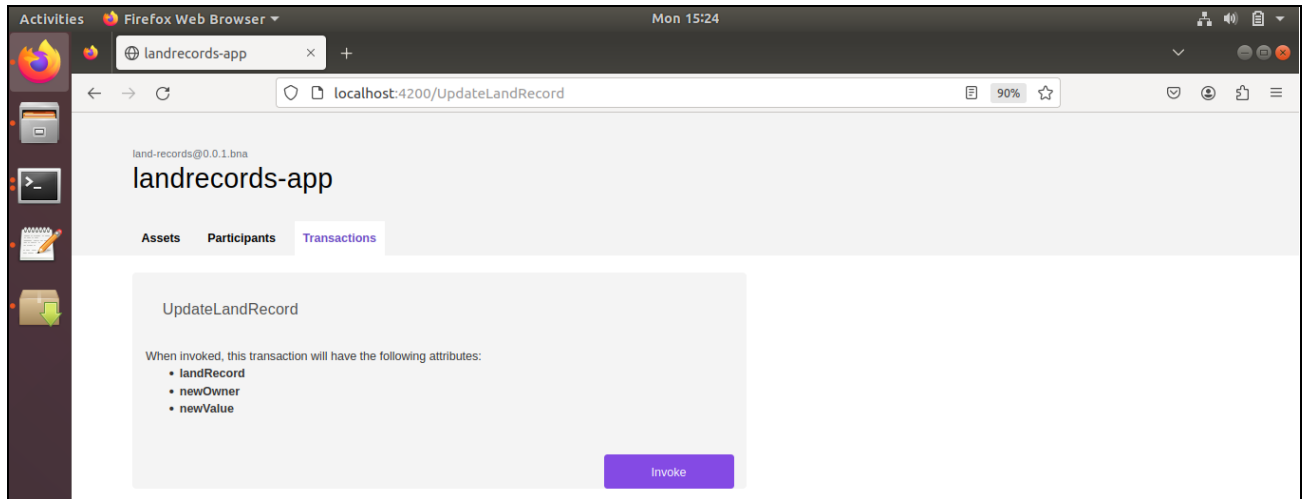


FIG-8: Transactions (Update Land Record)

5. CONCLUSIONS

In conclusion, developing a land record system based on blockchain technology, particularly leveraging Hyperledger Fabric, proves to be highly beneficial and commendable. Blockchain technology introduces a transformative paradigm shift in land record management, offering unprecedented levels of transparency, security, and efficiency. By immutably recording land transactions and ownership details on a decentralized ledger, blockchain significantly reduces the risk of fraud, corruption, and disputes inherent in traditional land record systems. Moreover, the utilization of Hyperledger Fabric adds a layer of customization and scalability, enabling tailored solutions to meet specific requirements of land management authorities and stakeholders.

The integration of blockchain and Hyperledger Fabric not only enhances the reliability and integrity of land records but also streamlines administrative processes, reduces paperwork, and fosters greater trust among participants. Furthermore, the decentralized nature of blockchain ensures seamless data sharing and interoperability, facilitating collaboration and coordination between government agencies, land registries, and property owners.

To enhance the project further, continuous research and development efforts should focus on optimizing performance, scalability, and user experience. Additionally, exploring innovative features such as smart contracts for automated land transactions and incorporating advanced analytics for data-driven decision-making could add significant value to the land record system. Collaborating with domain experts, policymakers, and technology enthusiasts to address regulatory and governance challenges would also contribute to the success and sustainability of blockchain-based land record systems. Overall, the adoption of blockchain and Hyperledger Fabric in land record management holds immense potential to revolutionize the way land transactions are recorded, maintained, and accessed, paving the way for a more transparent, secure, and efficient land management ecosystem.

6. REFERENCES

- [1]. <https://hyperledger.github.io/composer/latest/installing/installing-prereqs.html>
- [2]. <https://hyperledger.github.io/composer/latest/installing/development-tools.html>
- [3]. <https://hyperledger.github.io/composer/latest/tutorials/developer-tutorial>
- [4]. <https://blog.clairvoyantsoft.com/hyperledger-fabric-components-and-architecture-b874b36c4af5>
- [5]. <https://blog.clairvoyantsoft.com/hyperledger-fabric-transaction-flow-c6bcc2142b5a>