Towards a Land Records Administration Model in Vietnam using Blockchain Technology

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Abstract. The paper presents the solution using the advantages of blockchain technology such as decentralization and data stored as blocks to apply in the land records administration system. The purpose is to make transactions transparent and ensure data saved to the blockchain safe, without any unauthorized modification. We propose a land records administration system model with the following characteristics: Citizens have permissions to monitor and manage the land that they own and receive automated notifications when any changes occur to their properties. Government registrars are those who receive and check the land records before updating land records, the entire record and the update process are recorded on the system and checked oversight by higher management authorities as well as stakeholders. The verification of ownership can be done easily and quickly through notary offices. At the same time, we also apply Hyperledger Fabric platform to build a blockchain system for ownership transfer. The application provides a web-based interface for stakeholders to perform ownership transfer, receive notifications, validate, executive, and monitor transactions.

Keywords: transparent transaction, data security, blockchain, smart contracts, land records administration, Hyperledger Fabric.

1   Introduction

Blockchain technology has evolved and mentioned widely in recent years. If blockchain 1.0 is focused on currency, i.e. the implementation of cryptocurrencies in cash-related applications such as money transfers, deposits, and electronic payment systems, then blockchain 2.0 is toward aimed at transferring many other asset types than currencies. The idea is that the blockchain's decentralized ledger feature can also be used to register and transfer all types of contracts and assets. The next version, blockchain 3.0 are applications out of the scope of financial and market currencies - especially in areas such as government, health, science, literature, culture and technology, and art [1]. The transparency of blockchain is built based on decentralized data, the ledger is replicated and shared on peer nodes, the close connection between successive blocks is the basis to combat tampering or unauthorized information editing. In Vietnam, the implementation of digital transformation in the field of public administration is happening strongly. However, blockchain technology has not been widely used in this area yet.

The 2017 Provincial Governance and Public Administration Performance Index (PAPI) [2] involving more than 14,000 people who randomly selected from 63 provinces pointed to a number of remaining issues in the land sector. People cannot track information about their land assets on the system. Information land on the system is only visible to the government. Between the citizen's land records and records managed by the government in the system, there has not been consistent, giving rise to complaints and reflections on administrative produces in the process grant land ownership certificates. Citizens cannot track information about their land assets on the system. Land information on the system is only visible to the government.
In this paper, we propose a solution to apply blockchain technology in land records administration in Vietnam based on the advanced features of blockchain technology. In the next section, we will introduce blockchain technology background knowledge and the land administration business. The second section presents some researches related to blockchain technology for land records administration. The system

architecture model when applying blockchain in land records is presented in the third section. In the fourth section, we set up an example of ownership transfer based on the Hyperledger Fabric platform before reaching the final section of this paper, the conclusions.

2   Background knowledge

2.1   Overview of blockchain technology

Blockchain is a decentralized ledger, the transaction is encrypted and stored in blocks [1]. Blockchain is also defined as "a peer-to-peer distributed ledger forged by consensus, combined with a system for smart contracts and other assistive technologies" [3]. Smart contracts are immutable computer programs that execute predefined actions when certain conditions within the system are met [3, 4]. Blockchain expands over time and is operated and maintained by a group of participants who store and share this ledger.

The structure of a basic block consists of three main sections. The block header contains the block number, hash of the current block, and hash of the previous block. The data section contains a list of transactions included in that block. The metadata section contains information about the time the block was created, the certificate, and the public key of the writer who created the block.

When a peer receives a block from the network, it validates that block and then associates it with the existing blockchain by checking the new block header and the hash of the previous block.

The network architecture in the blockchain system is built based on the peer-to-peer network architecture. Any system that participates in the blockchain network through communication using a blockchain system protocol is called a node. Peer nodes maintain a local copy of the blockchain. The local copy of the blockchain is updated continuously every time a new block is discovered and is used to expand the chain.

The process to keep the blockchain ledger in sync to make sure the blockchain ledger updates data only when the transaction is approved by all participants and the transactions are updated in the same order is called consensus [5,6].

2.2   The land record administration in Vietnam

In Vietnam, a land record is a collection of documents showing detailed information about the status quo and legal of land parcels and properties attached to land to serve management requirements of government and information necessary to related organizations and individuals. Land records are made in digital form and stored in the land database, including documents such as land maps and land inventory books, cadastral books, and copies of land use right certificates.

The process of land records administration includes three main procedures: creating land records, updating and adjusting land records, and keeping confidential land records in accordance with the law [7, 8]. The land information system software currently used is the Vilis 2.0 [9]. The current land database is centrally organized, and the big problem of the centralized database is "Internal Attack". Data changes log may be stored on the system however they are completely easy for the unauthorized modification; this result is not being able to retrieve changes accurately when needed. It can be seen that blockchain has not been used in land administration in Vietnam, but in the world, there are many countries that have initially researched and applied blockchain in this field.

3   Related works

A recent analysis of the literature on this subject showing that much work has been carried out into the use of blockchain technology in land administration. In India, a blockchain-based land registry system using Ethereum Blockchain has been proposed [10]. That system stores all transactions made during land ownership transfers. Using Smart Contract, the system will activate different events such as land record access for land inspectors, and money transfer events from buyers to sellers after land ownership transfer verification. The system would also resolve the problems faced by all three stakeholders during the land registry process, which would also remove intermediaries such as real estate agents. This system makes the land registration process flexible and reduces fraud in the process. According to the survey [11], there are a number of countries that have pilot projects on land registration based on blockchain. In Brazil, a pilot

project with blockchain startup "Ubiquity" [12] to save land registration on the blockchain has been started. The system contains addresses, cadastral partitions, and owner information that is hashed and then mapped to a blockchain-based on the Col Coins protocol. Andhra Pradesh, India has partnered with startup ChromaWay to develop a blockchain-based land registry [13].

It can be seen that blockchain technology has been trial and implemented in many countries around the world in land records administration however each country has its own characteristics in land management, it is difficult to apply models in the above countries to land management in Vietnam, so we would like to propose a model for managing land records in Vietnam using blockchain technology.

4   System architecture model

Based on the advanced features of blockchain technology for the aim of transparent and secure information in the system, we will apply blockchain technology to build the Blockchain Land Record Administration System (B-Land).

4.1   Stakeholders involved in B-Land system

- Citizen is defined as a person who is legally recognized. The system has functions to meet citizens requirements:
  - Searching general information about the land plots.
  - Receiving automated notifications and sending confirmation about their decision for changes that occur on the land plots they owned.
- Supervisory authority is considered as an official from the land registration government agency, who will perform monitoring changes in the land database.
  Functions in the system that will meet their activities:
  - Viewing all data in the land database.
  - Getting notification when any changes occur in the land database.
  - Retrieving all records about changes in the land database including information about the person who made the change, the time when the change occurred, the content of changes in the database.
- Government registrars: An official from the land registration government agency, who will be responsibility for declaring registration, granting certificates of land use rights, and creating land records. At the same time, the government registrars also register and manage land changes. The government registrars are the main participants in the B-Land system. B-Land system includes two sub-systems to meet these activities:
  - Declaring registration, granting certificates, and creating land records
  - Registering and managing land changes
- Notary office is an agency performing activities of certifying the owner of the land. A notary public can verify whether or not the seller is the owner of the land.

4.2   Use case diagram

The overview use case diagram, in Fig. 1 below, summarizes the main functions provided to the stakeholder:
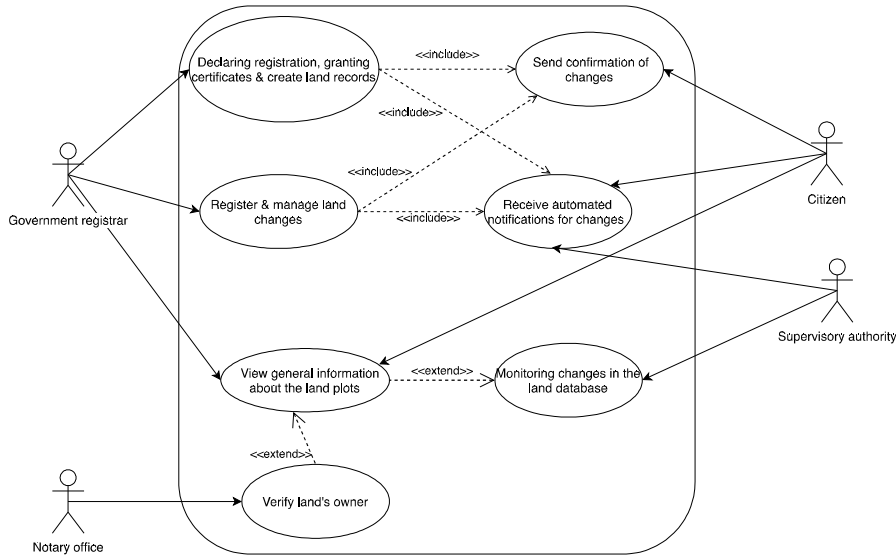
Fig. 1. Use case diagram.

4.3   Activity diagram

To describe the process of operation and interaction of the parties in the system, we simulate the activity flow corresponding to each party as shown in Fig. 2. In the activity diagram, the blockchain system with a central role, the stakeholder after logging in and authenticating the permission and identity system can choose and perform the functions corresponding to the role of them in the system.
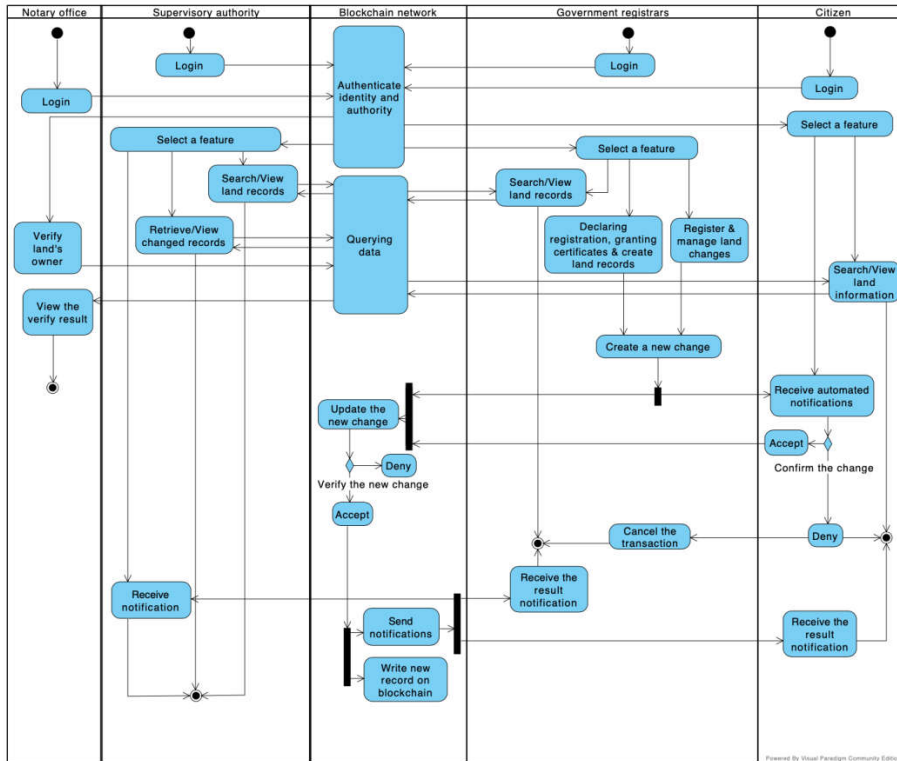

Fig. 2. Activity Diagram

4.4 Architectural model

In this system, we divide into two operating phases:
- Phase 1: Converting the already digitized land database into the B-Land system, this only needs to be done once when initializing the system, with this data the system is ready for operation dynamic query of land data.
- Phase 2: Stakeholders can perform the functions that have been granted permission on the B-Land system.

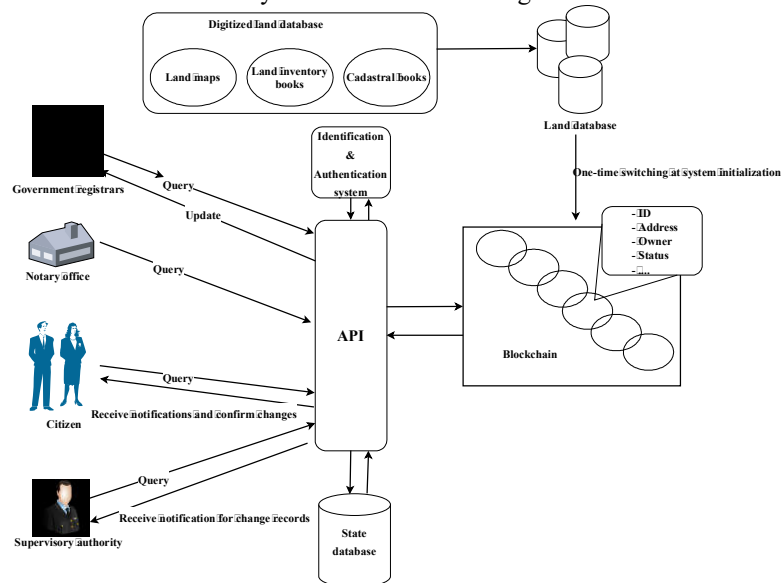The architectural model of the B-Land system is illustrated as Fig. 3.

Fig. 3. The architectural model of the B-Land system

4.5 Smart contracts are installed in the system

The system runs several smart contracts to validate the incurred activities:
- Initializing blockchain: init
- Checking the existence of a record: checkRecord
- Creating a new record: putRecord
- Updating record details: updateRecord
- Querying records: queryRecord
- Transferring ownership: tranferOwner
- Viewing the history of changes in records: viewHistory
- Authenticating a owner: checkOwner

4.6 Ownership transfer example

The ownership transfer is one of the basic activities in the land record administrator system. Transparency in this activity will help reduce many negative phenomena such as illegal trading, forging papers, land disputes. To illustrate the B-Land system model for land records administration, within the scope of this paper, is used the Hyperledger Fabric Platform to settings for a detailed case: transfer ownership between two citizens.

4.7 Hyperledger Fabric platform overview

Hyperledger Fabric [5] is an open-source decentralized blockchain platform, built for private applications in enterprise environments. Hyperledger Fabric provides a modular architecture that separates the roles between nodes in the network architecture, enabling integration and execution of smart contracts (chaincode). The Fabric network consists of peer nodes that execute chaincode, access to ledger data, confirm transactions, and also provide the interface that allows applications (client) to connect to the network. In addition, there are nodes in the network that arrange the order of transactions to ensure the consistency

of the blockchain network, and then re-distribute endorsed transactions to the peer nodes of the network. These buttons are called Orderer, they will operate consensus mechanisms such as Solo, Kafka, Raft. All components of the network are authenticated and decentralized roles using a service provider system called Membership Service Provider (MSP).

4.8   Demonstration model

When a transfer ownership transaction arises, the people are divided into the seller and the buyer. Therefore, stakeholders in the system include the seller, the buyer, the government registrars, the supervisory authority, and the notary office. The transfer process can be divided into 3 phases: before, during, and after the transaction arises. In each phase, each stakeholder will have different actions as shown in the Fig. 4.
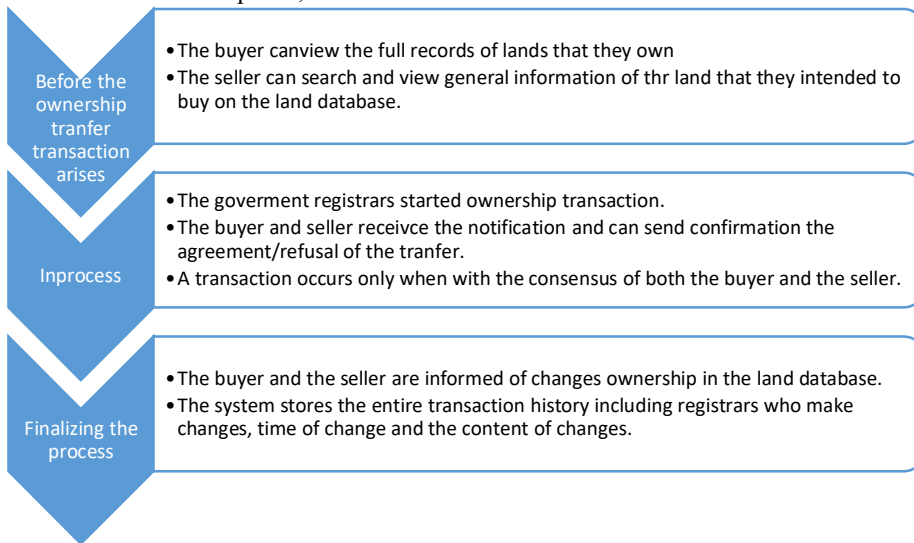

Before the ownership tranfer transaction arises
- The buyer canview the full records of lands that they own
- The seller can search and view general information of thr land that they intended to buy on the land database.

Inprocess
- The goverment registrars started ownership transaction.
- The buyer and seller receivce the notification and can send confirmation the agreement/refusal of the tranfer.
- A transaction occurs only when with the consensus of both the buyer and the seller.

Finalizing the process
- The buyer and the seller are informed of changes ownership in the land database.
- The system stores the entire transaction history including registrars who make changes, time of change and the content of changes.

Fig. 4. The transfer processes

Corresponding to the above stakeholders, the system consists of 2 separate organizations (org):
- org1: an organization for citizens only
- org2: organizations for state agencies including the government registrars, the supervisory authority, and the notary office.

Each organization will be set up with 2 separate peers. Each peer has installed the system's smart contracts (chaincodes) as described in section 3.5 and uses CouchDB as the status database. Each organization also has its own Certificate Authorities, which manages the provision of digital identifiers to access the organization. In this system, we will use and set up an Orderer node for the system and all organization are connected to this Orderer node. At the same time, the transactions of the system are also put through this Orderer node to be arranged in order and distributed to peer nodes (for endorsed transactions). In addition, the system can also provide a Web service, to help users interact more easily. The network diagram for the transfer ownership transaction is shown the Fig. 5.
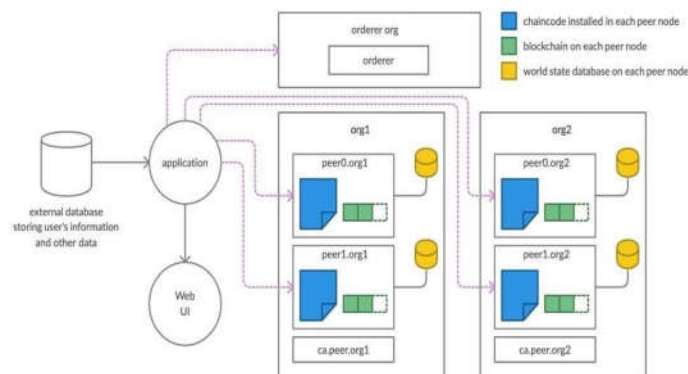

Fig. 5. The network diagram for the transfer ownership transaction

Some of the main interfaces of the system as shown in Fig. 6 and Fig. 7.

Fig. 6. Land ownership transfer interface for the government registrar

Fig. 7. Viewing notifications interface for seller

5 Conclusions

We just present the solution to apply blockchain technology in the land record administration process. The B-Land model solves the existing problems in the cadastral record management process today in Vietnam and there are many advantages such as automated notifications which are sent to citizens when there are any changes regarding their properties in the land database. Transparency of transactions only occur when there is consensus between all parties involved. The history of changes is detailed and clear, including the identity who made the change, the timestamp of the change and the change's content. Contracts and rules are all saved as digital documents on the system. Data is stored securely and without unauthorized modification. Blockchain technology obviously has the potential to assist in land records management. However, blockchain technology in general and blockchain applications in land management in particular are still being developed and tested. The current way of managing land records in cadastral records is still successful and does not require a blockchain application. But the use of blockchain technology will certainly optimize and make transparent the administration's operations even though it will not completely replace them.

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