



# **GROUP ASSIGNMENT**

**CT124-3-3-BCD**

## **BLOCKCHAIN DEVELOPMENT**

**HAND OUT DATE : 9/10/2023**

**HAND IN DATE : 17/11/2023**

**WEIGHTAGE : 25%**

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### **INSTRUCTIONS TO CANDIDATES:**

- 1 Submit your assignment at the Moodle System.**
- 2 Students are advised to underpin their answers with the use of references (cited using the APA Style System of Referencing)**
- 3 Late submission will be awarded zero (0) unless Extenuating Circumstances (EC) are upheld.**
- 4 Cases of plagiarism will be penalized.**
- 5 The assignment should be submitted in softcopy, where the softcopy of the written assignment and source code (where appropriate) should be on Moodle System.**
- 6 You must obtain 50% overall to pass this module.**

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## **1.0 Introduction**

### **1.1 Land Registration**

Land registration is an essential procedure carried out by the government to record and uphold information regarding land parcels within a specific jurisdiction. Its principal objective is to establish and validate ownership, boundaries, and legal rights associated with a particular piece of land. This process serves as crucial verification of property ownership, a foundation for land taxation, and protection against fraudulent land transactions (Humdullah et al., 2021).

The conventional method of land registration is widely acknowledged for its intricacy and inefficiency, as it raises apprehensions about data tampering, vulnerability to security breaches, and the risk of system malfunctions. Moreover, the involvement of numerous stakeholders further complicates the process. However, Blockchain technology offers a promising solution by establishing a decentralized network in which information must be verified by all nodes before being added to the blockchain. This consensus-driven approach not only guarantees data integrity but also fosters trust among users regarding shared knowledge within the system.

### **1.2 Blockchain in Land Registration**

In the real estate industry, the registration of land is highly reliant on the management and verification of data. Current practices involve manual record-keeping methods, such as paper-based systems, that are prone to errors, data loss, and unauthorized modifications. Having various intermediaries in the industry caused a more complex and time-consuming process. Furthermore, the lack of a centralized and standardized database contributes to discrepancies in land records which result in disputes, prolonged legal proceedings, and difficulties with property transfers and financing arrangements (Khalid et al., 2022).

Blockchain technology presents a potential solution to the obstacles faced in land registration, offering improved efficiency and data accuracy. By leveraging this innovative technology, the land registration process can become more secure, transparent, and accountable compared to traditional methods. In the following sections of this report, various use cases where blockchain can be applied in land registration and discuss its practical implementation to revolutionize the real estate sector will be explored.

## **2.0 Importance of the Issue**

In the digital age, land registration adheres to several challenges. Data integrity breaches occur often, casting doubt on the legitimacy of real estate. Paper-based registrations that are ineffective primarily rely on bureaucratic processes, which causes systemic inefficiencies. Additionally, a lack of accountability and transparency in land registration procedures provides a fertile environment for corruption and illegal activity. Further complicating issues is the inability of legal and regulatory frameworks to keep up with technical development, which raises questions about the legitimacy of blockchain applications for land registration. However, by offering answers to these persistent problems and developing a more secure, transparent, and dependable method for land registration, blockchain technology could revolutionise this industry.

### **2.1 Integrity of data**

As the foundation for reliability and trust in property ownership records, maintaining the integrity of data within land registration systems is of utmost significance. Data integrity means that the information being accessed is accurate and has a reliable source behind it. It guarantees that the data is straightforward, legible, concurrently recorded, and distinctive. The veracity of the information provided in land registration applications has unfortunately been called into question due to the inadequacy of traditional centralised database systems in ensuring data integrity (Humdullah et al., 2021). The implications of this issue are extensive since a lack of ownership data for many properties is sometimes caused by inadequate transaction history preservation. The trust that potential purchasers of real estate have in the legality of land ownership is considerably diminished by this lack of transparency, which eventually undermines faith in the entire land registration system (Soner et al., 2021). While having certain advantages in terms of convenience, these systems' centralised design also increases the risk of data tampering and inaccuracy. The trustworthiness of a single point determines the integrity of the data, making it vulnerable to manipulation because traditional land registration methods lack a decentralised, consensus-driven structure. Addressing these issues with data integrity is essential to improving the trustworthiness and reliability of land registration. Through the implementation of blockchain, it is possible to handle data in a decentralised, tamper-proof manner, assuring the quality and reliability of land registration records.

## **2.2 Fraudulent Activities and Scams**

Detecting fraudulent activities and scams within the current paper-based land registry system presents a formidable challenge. Even when records are digitized and stored in a centralized database, this approach poses a significant single point of failure, making it vulnerable to data manipulation (Soner et al., 2021). The complex and bureaucratic channels associated with land registration procedures inadvertently create openings for exploitation. These issues are made worse by administrative corruption, which involves bribes and dishonesty during the acquisition of documents and land registration. This system's underlying deliberate inefficiency has given rise to an intermediate layer that further complicates the process and increases expenses while decreasing transparency. The existing level of inefficiency and delay in the market frequently leads to fraudulent transactions and the emergence of local brokers who benefit from these difficulties (Edwin et al., 2020). Additionally, digitising public documents does not automatically resolve data synchronisation problems or build trust amongst the parties concerned. A portion of the lack of synchronisation results from the system's vulnerability to insider assaults. Property purchasers thus frequently discover that they are needed to methodically review years' worth of documentation to confirm property titles. In addition to these issues, the system is still dealing with the enduring problem of forgery-based fraud. The issue of fraud in land registration extends beyond unauthorized individuals to encompass identity fraud, document alterations, and interference by property agency officials (Humdullah et al., 2021). These challenges highlight the need for comprehensive solutions to improve the integrity and security of land registration systems.

## **2.3 Legal Assurance and Protection for Property Rights**

Conventional methods of land registration often fail to provide the necessary legal assurance and protection for property rights. Land registers frequently do not accurately reflect the true legal status of land or its rightful owner. These inaccuracies can result in conflicts, making it difficult for landowners to assert their rights or mount a defense in court. Additionally, this lack of accuracy creates uncertainty for prospective buyers and investors who may encounter challenges verifying the authenticity and security of land titles, exposing them to financial and property-related risks (Kaczorowska, 2019). Furthermore, there is often a lack of transparency and accountability in the land registration procedure. It frequently functions in

an enclosed setting with limited external scrutiny, making it difficult for organizations like the media to monitor and preserve its integrity. Given the absence of accountability and transparency, there is an opportunity for a variety of consumers to take advantage of the system and commit fraud or corruption (Garcia-Teruel, 2020). To provide legal certainty, a number of legal and regulatory issues with blockchain-based applications must be resolved. Liability, accountability, dispute settlement, enforcement, and cross-jurisdictional borders are a few of the difficulties that must be addressed. Due to the decentralized structure of blockchain transactions, authorities may have trouble determining liabilities and obligations in the absence of intermediaries, and dispute resolution becomes more complicated. To create a legal framework for blockchain-based transactions and solve these issues, there must be clear legal and regulatory backing (Rizal Batubara et al., 2019).

### 3.0 Data Analysis

#### 3.1 Database Schema

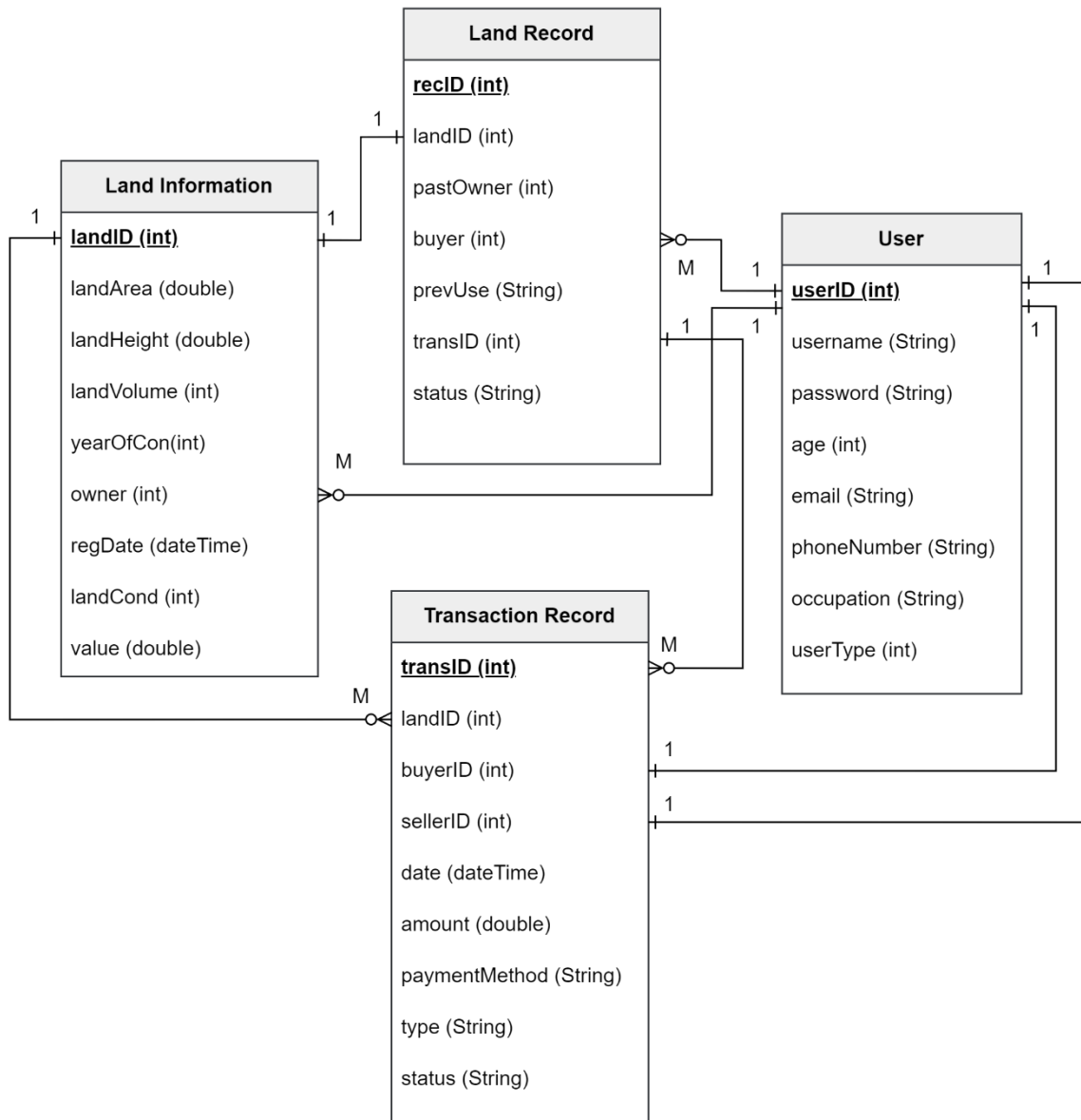


Figure 1: Database Schema of Land Registration System

During the detailed planning stage of developing a land registration system that incorporates blockchain technology, thorough consideration is given to the database schema. This framework is meticulously designed to encompass various aspects such as land information, ownership record, user information, and transaction. Each table within the schema plays a vital role in ensuring the integrity, transparency, and security of the system.

The central dataset in the land registry system, known as **Land Information**, it contains essential information regarding each individual parcel of land. This includes data fields such

as area, height, volume, year of construction, current owner, registered date, land condition and land value. The integration of blockchain technology strengthens the overall system by providing an additional layer of security and transparency to ensure that all recorded details remain unchanged over time. Additionally, through its connection with the user table's owner field, ownership history can be seamlessly tracked within the system.

Furthermore, **Land Record** records the dynamic changes in land ownership by connecting previous and current owners, previous land usage, transactions, and land status. Each field within the table plays a crucial role in capturing the complete lifecycle of land ownership records. This approach guarantees that the system not only documents the present condition of land ownership but also offers valuable insights into its past progression, enhancing overall transparency and dependability in the land registration process.

In parallel, **User** contains important user data that is necessary for secure verification and customized interactions within the system. Details such as username, password, age, email address, phone number, occupation and user type contribute to a smooth user experience. The field user type differentiates between administrators and customers to determine access levels and system permissions. By incorporating blockchain technology, the protection of user information is strengthened, enabling a strong basis for managing identities.

Lastly, **Transaction Record** comprehensively documents the financial aspects of land transactions. It includes fields such as transaction ID, land ID, buyer ID, seller ID, transaction date, transaction amount, payment method, type of transaction, and transaction status to capture transaction details. The Transaction Record table is important in consolidating and structuring vital data pertaining to financial transactions linked to land assets.

In the comprehensive planning of a land registration system integrated with blockchain, the database structure includes important aspects such as Land Information, Land Record, User, and Transaction Record. By implementing these tables within the system's framework with blockchain technology, a strong foundation is established that ensures both integrity and transparency throughout the entire process of land registration.



### 3.2 Data Analysis Categorization

Table 1: Land Registration System Data Categorization

Significant	Insignificant
<p>Unique Identifiers:</p> <ul style="list-style-type: none"> <li>• Land ID</li> <li>• Record ID</li> <li>• User ID</li> <li>• Transaction ID</li> </ul> <p>Ownership history:</p> <ul style="list-style-type: none"> <li>• Past Owner</li> <li>• Buyer</li> </ul> <p>Financial Aspects:</p> <ul style="list-style-type: none"> <li>• Land Area</li> <li>• Land Value</li> <li>• Transaction Amount</li> </ul> <p>Authentication:</p> <ul style="list-style-type: none"> <li>• Username</li> <li>• Password</li> </ul>	<p>Land Details:</p> <ul style="list-style-type: none"> <li>• Year of Construction</li> <li>• Land Volume</li> <li>• Land Condition</li> <li>• Land Previous Usage</li> </ul> <p>User Details:</p> <ul style="list-style-type: none"> <li>• User Occupation</li> </ul> <p>Transaction Details:</p> <ul style="list-style-type: none"> <li>• Payment Method</li> </ul>

In a land registration system, data can be categorized as either significant or insignificant. This categorization helps identify the crucial elements that are essential for the core functionalities of the system and those that are less important in their contextual relevance.

**Significant data** consist of the use of unique identifiers such as Land ID, Record ID, User ID, and Transaction ID play a crucial role in the system by uniquely identifying and linking important records. Ownership history that includes information about past owners and buyers is essential for establishing a complete lineage of land ownership changes. Financial aspects like Land Area, Land Value, and Transaction Amount are critical for assessing the monetary dimensions related to land transactions. To ensure secure user interactions within the system, authentication data such as Username and Password hold significant importance.

Conversely, some information is considered less important in the broader context of the land registration system which are categorise under **insignificant data**. Details such as Year

of Construction, Land Volume, Land Condition, and Land Previous Usage are not deemed essential unless specific use cases or regulations require their inclusion. Similarly, User Occupation may be seen as less critical for the overall functionality of the system. While Payment Method is relevant to transactions, its significance may vary depending on the level of detail required for financial purposes.

Essentially, the land registration system relies on important data to fulfil its primary functions such as identification, ownership tracking, financial assessments, and secure user interactions. However, less crucial data may not be universally vital for the system's core operations. Categorizing these different types of data helps in designing and optimizing the database schema by prioritizing the capture and management of essential elements necessary for its intended purpose.

## **4.0 Analysis Solution Model**

The objective of the suggested blockchain solution is to improve the traceability and transparency of property records in the sector by storing relevant data for land registration. Blockchain technology greatly enhances the protection of vital data, guaranteeing the legitimacy and accountability of important documents including those pertaining to real estate ownership, transactions, and related paperwork. A strong foundation for preserving the integrity of land registration records is provided by the immutable nature of blockchain, which guarantees that data cannot be changed or erased once recorded. Every transaction is painstakingly recorded by the distributed ledger that is built into blockchain technology, producing an extensive record that is available to all parties participating in the land registration procedure. This covers organizations like landowners, law enforcement, and other pertinent stakeholders. The proposed blockchain architecture ensures that all participants in the land registration ecosystem have access to accurate and up-to-date information.

Individuals engaged in land transactions benefit from a simplified process made possible by this transparency. Owners of real estate have easy access to information about their property, such as past ownership history, legal transactions, and related paperwork. In a similar vein, land records can be effectively verified and authenticated by government agencies and legal bodies. In the end, the tracking of property ownership and history is made easier by the use of blockchain in land registration. Increased traceability benefits landowners and regulatory agencies involved in land management by making the land registration system more reliable and efficient.

## 4.1 System Architecture

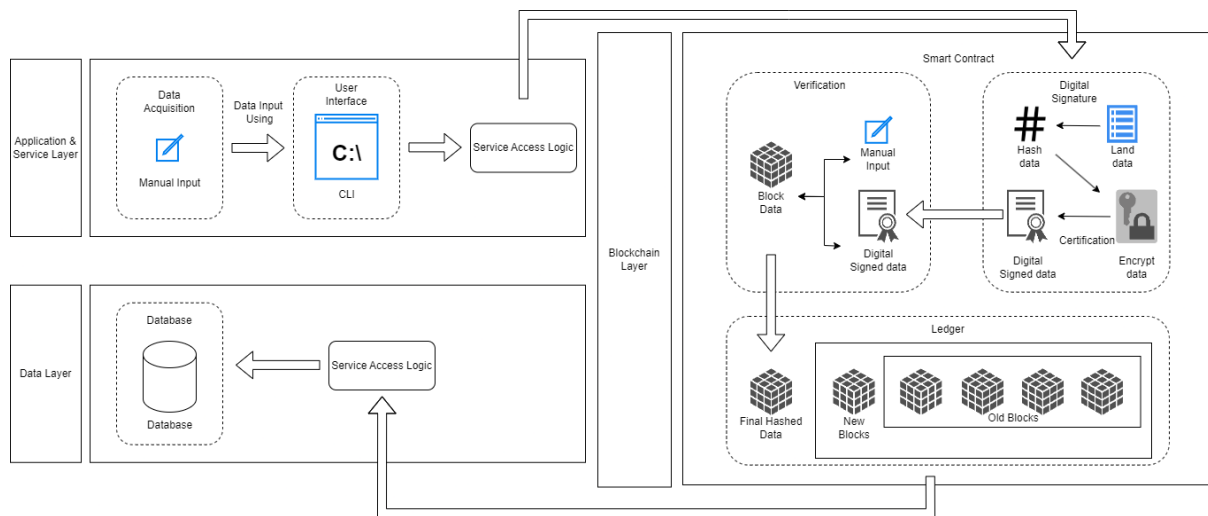


Figure 22: System Architecture of Land Registration System

### Application Layer and Service Layer

In the land registration, the user will input all of the necessary land details along with the latest landowner information. All the services under this system will be accessed via Command Line Interface (CLI) and all service access logics will be stored in the service layer.

### Blockchain layer

For each registered land, the system will create a smart contract for the land by encrypting the land data and current owner data with the digital signature. The encrypted land data will be verified in each land transaction, where the land record will be scanned, and the scanned data will be compared with the system data. If both decrypted data are the same, it means that the land record has not been modified and it will be transferred to the new owner. Once the transaction is completed successfully, the land record will undergo another round of encryption before the hashed data is stored into a newly generated block. The newly generated block will store at the end node of the previous block(s). In this implementation, it is not possible to modify any of the block during the system operation, and any modified cases will lead to a system warning.

## Data Layer

The blockchain information such as data encryption, timestamp, nodes will be stored into the database in each operation. Also, other data information in the system such as system modules will be stored in the database as well.

## 4.2 Use Case

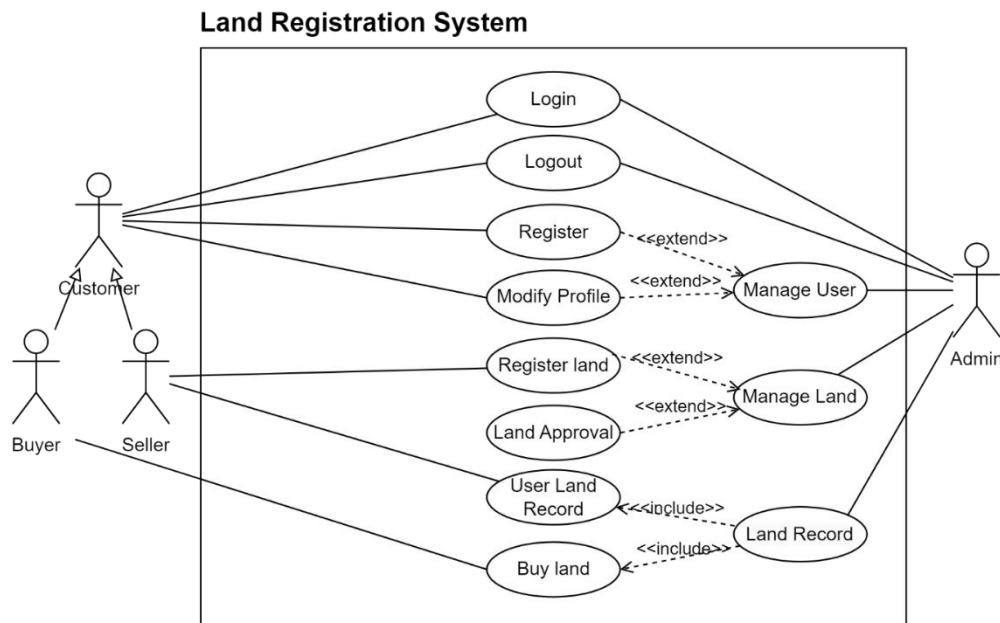


Figure 33: Use Case of Land Registration System

The use case diagram for the Land Registration System depicts the roles and interactions of two main actors, which are customer and administrator. The customer category includes two subtypes, seller, and buyer, showing a hierarchy relationship for the encapsulation of shared functionalities and specialized features.

Customers engage in basic use cases that are necessary for user interaction with the system. These consist of procedures like registering account, log in, and log out. Additionally, a shared feature enables users to modify their account details, including login credentials and personal information. This standardized approach ensures a seamless and uniform user experience across all roles within the system. In the land transaction process, sellers have the authority to register and access their land records. They can also manage the status of their land by updating information and listing it for sale. On the other hand, buyers can purchase listed properties and initiate a procedure to claim ownership. The integration of blockchain technology ensures transparency and security in this process, which is crucial for its success.

The Land Registration System is overseen by an Administrator who plays a central role in facilitating interactions between sellers and buyers. The responsibilities of the Administrator include managing user accounts, approving seller registrations, and overseeing all stages of land transactions. This involves registering new lands, approving procedures, and updating land records after transactions are completed. By incorporating blockchain technology into the system, the security and transparency of these transactions are significantly improved, thereby increasing the overall reliability and credibility of the Land Registration System.

## **5.0 Benefits of Blockchain Integration**

There are many benefits when it comes to integrating blockchain technology into land registration. Blockchain allows for the recording and storing of all land registry modifications in a decentralized ledger that is not controlled by a single party. Because modifications to records require approval from several parties, this makes it more difficult for malevolent actors to alter or manipulate records. Blockchain records also have a time stamp. Supplying a precise record that facilitates the tracking and administration of property rights.

The following characteristics of Blockchain technology are essential to its status as one of today's most promising technologies for land registration. First, the data will be permanent, which means that it cannot be corrupted because it is permanently kept and cannot be erased or changed. In order to get information on the land, the landowner can use this to find out who the previous owners were and get in touch with them. The next element is time-stamped records. At the moment of registration and ownership transfer, every piece of data entered into the Blockchain is digitally recorded. Next, the participants have easy access to the data records, allowing them to examine or add data in accordance with their given consent. It is decentralized, to sum up. A collection of blocks that are not governed by a single entity are responsible for maintaining the network. With the use of the private key, any data, including contracts, important papers, and other data, may be directly controlled and securely saved. (Singh, 2020)

## **6.0 Conclusion**

In conclusion, incorporating blockchain technology into land registration provides a plethora of benefits that have the potential to transform the way we manage property ownership data. Due to its inherent immutability, security, and transparency, blockchain technology can successfully address issues with traditional land registration systems like fraud, title disputes, and inefficient procedures. Governments and land registries may develop a more secure, transparent, and efficient land registration system that encourages confidence, protects property rights, and supports economic growth by developing blockchain-based solutions.

All things considered, incorporating blockchain technology into land registration offers a revolutionary chance to modernize and simplify property management procedures. Governments and land registries can establish a more efficient, transparent, and safe land registration system that is advantageous to all parties involved by utilizing the special qualities of blockchain technology.



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