



BLOCKCHAIN-BASED SYSTEM MODEL FOR LAND REGISTRATION MANAGEMENT

¹Adam Musa Safiyanu, ²Aimufua G.I.O

¹Student, ²Asst. Professor

Nasarawa State University, Keffi

Keffi Nasarawa State

Abstract: The land is a fixed property. Finding the details of property and involvement of third-party is a challenging task. Fraudsters may forge documents and mislead the purchaser and if it's a disputed land it takes many years in the court battle, a waste of time and resources. Problems escalate in this current land registration process which is not clear. Such calls were made to integrate technologies and lead to the growth of blockchain technology. Blockchain is a decentralized and transparent ledger. The smart contract is an empirical and permanent document between two parties. This proposed framework is used to develop a land registration application system in which the new buyer has to register and continue with the further process. The proposed research work is implemented using the SHA256 algorithm which provides unique hash values for the messages getting stored in blocks and Ethereum blockchain technology is used to store both smart contract and transaction details.

Index Terms -**Framework, Decentralized, Blockchain, Land Registration Platform, Smart Contract SHA256 Algorithm.**

I. INTRODUCTION

The land registration management system involves a massive amount of registration documents to be stored on central databases that facilitate the transaction for the trading of land title. This system is prone to various type of exploitation and modifications and to sort out these issues, manual records stored that it can be manipulated with the help of corrupt employees in the registry office and involves many overheads in the form of time, storage requirements and cost involved in storing and processing the documents. The land registration departments have taken initiatives to take advantage of the ICT technologies for increasing openness and transparency. By distributing, the data from a single database to a distributed database protect the central storage by copying and replication of data [15]. However, the correctness of records is still a question, and it is still prone to alterations and scams. The Blockchain in reference to the land registry system can be described as a distributed ledger having functions such as storing all the transaction record, owner of the land for a certain period, time of transaction. It also offers ways to track the data of previous transactions [16]. Application of blockchain technology in the land management solve many problems that arise due to keeping a centralized record of titles. A blockchain based land registration management system will provide many abilities as compared to the old registration system. In blockchain, there is a decentralized control and storage of records that have the potential to increase the trust and give rise to the collective system. By using blockchain, the efficiency of the land registration system will be increased and result in better synchronization and countering the security issues resulting from human-made disasters and availability issues of information [17]. Blockchain technology consist of peer to peer network connected by distributed network in which each peer is holding the same copy of transaction made via consensus of all the peer in the network [18]. The blockchain categorized based on Public or private and the permission of peer in the network. The tampering with the authentic transitions in land registry record or the efforts to

temper the old records creates the audit trail on the ledger [20]. The blockchain technology permits to have peer defined chains for the entry of the transactions, Peer-based validation of entries, a consensus mechanism for storing the entries and a medium to guarantee the security of the system [21].

II. Related Works

Various blockchain implementations in the field of land registry have been reviewed. Majority of implementations are either in initial or development stage. Some of them have been in pilot testing phase. This section presents a brief discussion of the existing blockchain implementation projects in the field of land registry. Thakur conducted a comprehensive study about existing land records management system of India, how it can adopt Blockchain technology to improve the current system and possible questions that need to be addressed to move in that direction. They provide a model of Blockchain-based land titling system for India but fall short of describing the smart contract scenarios, public key infrastructure (PKI) and type of architecture (i.e. public, private, hybrid) to be adopted to implement that. As recommended by the authors of Graglia and Mellon, 2018, it is not practical to move an old model to Blockchain without laying out an incremental policy for real-life adoption [11].

In Mukne authors present another land title management system for India using permissioned Blockchain such as Hyperledger Fabric and store documents using Inter Planetary File System (IPFS). The authors mention that the biggest challenge is to move existing land records to the Blockchain system [14]. In Hasan and Salah, authors present an Ethereum based digital asset (e.g. file, book, image, video, or music) exchange system with a proof-of-delivery mechanism using a viable PKI model. In this paper, the authors present implementation details and algorithm models to reproduce the proposed system [13]. Almost all of the authors talk about how blockchain-based land registration management or land titling management system model was developed in order to reduce the required number of physical documents, necessary steps, and overall expenses, while others like Georgia try to implement blockchain-based model to reduce corruption and mismanagement for their land ownership registries. Furthermore, all the models are based on different countries land registration system. However, most of the models considered the smart contract scenarios, mode of payment for land purchases to be made either in full or partial, public key infrastructure (PKI) and the types of architecture open permissioned, permissioned blockchain, consortium or hybrid), to be adopted for implementation.

A. Issues with Current Land Registration Management System

In the existing land registry system, the land registrar cannot verify any existing dues on the land and registrar will act assuming that all the land dues are clear [9]. The registry office only makes a record of land transactions, and it works based on the payment proof submitted by the seller and buyer but cannot verify its validity independently and actual payment made [10]. The land registry system depends upon the government departments for processing and the verification. As all the land register database are not connected to the land registry system, it reduces the efficiency and equality of the system. There are many issues related to Paper-based land registry system that has been summarized in this section. As the land registry system is not digitalized, it is prone to the alteration [12]. The process of land registration is lengthy and requires lots of paper verification, physical visits, check and bribery at every stage that causes a lot of delay and wastage of time and money [15]. Availability of record is another major issue as the process of land registration involves a change of owners from time to time that takes time and it cannot provide real time details for any verification. Assessing these records require time, lots of visits and bribery and that records also may not be synchronized [3]. Land title issue is very conflict arising matter as most of the cases in the court of land related issues are of land title dispute due to various reasons like double spending, fake records and unable to rightly identify the genuine owners [16]. Land double spending issue arises due to the synchronization issue in the land registry system, and it is prone to tampering. The same person can sell the same piece of land to multiple parties, and it can be traced at the later stage when the land mutation is being done. Paper-based systems are very much prone to such issues [18].

Other issues related to land registry system is related to Land encroachment as in most of the countries, the unoccupied land is prone to encroachment. In some cases, online registration is being done to sort out some of these issues, but the server issue is a big concern. At the same time, any online system is prone to various type of hacking issues, and users cannot easily trust the system unless and until there is a full proof mechanism to counter any tempering. Middleman issue is another problem as in land

registering system the middleman charges a considerable amount to smoothen the land registry process. In some cases, the false middleman can sell the land with fake documents [19]. Due to all these reasons a big chunk of assets remains unutilized and unregistered that affect economic growth [20]. The financial benefits like revenues in the form of income tax, property tax etc. lost from the national exchequer [21]. All these issues reflect as Trust Gap in land registry system and land investors have lost money due to these reasons. Also, there is high transition cost for the purchase of land as compared to the other investments, and after getting the registered paper of land, there is a risk of criminal threats from local criminals [20].

III. Methodology

The purpose of the implementation of this methodology is to avoid fraudulence in land registration and to secure their transaction details. The main problem in the existing system is purchaser did not use to get the actual property details due to imposters. So here we are using Ethereum blockchain technology which is transparent, immutable, and decentralized [3]. In the blockchain, we are creating a land registry platform where all the details of the property which are earlier registered will be stored on a decentralized database, which is transparent, so any individuals who wish to purchase a property can cross-verify the complete details of the property. Details of each land will be stored in the form of a block and a digital title will also be given to make search efficient, where for each block a unique hash value will be assigned by using the SHA256 algorithm. Searchers can search the property with digital titles in that land registry platform. The overview of the mathematical model is shown below.

A. Mathematical Model for a Blockchain-Based Smart Contract System for Land Registration management.

The researcher presents a mathematical model that demonstrates how the system works. This is because it employs precise language to aid in the formulation of ideas and the identification of underlying assumptions. Furthermore, mathematical modeling can be used to explain a variety of phenomena. For this project, the following objects have been identified.

Let the objects = {G, M, N, R, W, O, L, T, B, S, U}

Described as follows.

G = Governor

M = Wallet

N = NAGIS

R = Revenue

W = Surveyor

O = Legal office

T = Traditonal Council

L = Set of lands = $\{L_1, L_2, \dots\}$

U = Set of users

S = Set of sellers = $\{S_1, S_2, \dots\}$ where each user/seller, S_i registers and becomes part of the system, $S_i \in U$ and possesses some lands represented by $S_i \rightarrow \{L_{m-1}, L_{m-2}, L_{m-3}, \dots, L_0\}$, where L_0 means **no land**. A user can have none or many lands in the system.

B = Set of buyers = $\{B_1, B_2, \dots\}$ B_i registers and becomes part of the system, $B_i \in U$ and each buyer B_i can make land L_i purchase request $Req(B_i, L_i)$ if $A(L_i)$ equals 1. $A(x)$ is availability function, it computes if a land is available for sale or not. This function produces $a \in \{0, 1\}$ where 0 means unavailable and 1 means available. The function $A(L_i)$ returns 1 if and only if the land selling state is SL_i 1, otherwise it returns 0.

Let $V(T, L_i)$ be a verification function, where a is the entity verifying land L_i and $BU(b_i, \dots)$ be a function that update the state of lands.

For every Land request $Req(B_i, L_i)$, the following must hold.

$A(L_i) = \alpha$, $V(T, L_i) = \alpha$ and $V(N, L_i) = \alpha$, where $\alpha = 1$

Which means that it is required for the land to be available for sale, verified by Traditional council and NAGIS. The land in this case will have to be verified with all the documents uploaded and available for a buyer to search in the system.

if $\alpha = 1$, then all the land state get updated and the buyer B_i must be ready in the sense that the returned value of $V(M, L_i) = 1$, meaning the buyer must be capable of paying for the land depending on the agreement reached and in this case, the land state will be toggled and $SL_i = 0$.

The buyer then proceeds with making payment providing that the preceding conditions are met.

For the whole transaction and transfer of ownership to be complete on the land L_i ,

The Governor must endorse the land,

$$D(G, L_i) = 1 \text{ and}$$

$$V(T, L_i) = V(N, L_i) = V(W, L_i) = \alpha, \text{ where } \alpha = 1$$

if $\alpha = 1$, i.e the land has been endorsed and verified, then all necessary blocks, $BU(b_1, b_2, b_3, \dots)$ get updated updated again to persist the last new state of the land.

IV. Implementation: Framework for Blockchain Based Land Registration Management System

- a. Nasarawa Geographical Information System (NAGIS): NAGIS initiates and governs the blockchain platform, overseeing the technical aspects of network setup, configuration, maintenance, and security. They verify and approve land for sale on the platform.
- b. Paramount ruler/District Head: Traditional land verification roles of banks and revenue offices are replaced by local community leaders who possess a deep understanding of land ownership. They provide accurate verification of land authenticity within their respective communities. Blockchain Wallet: It serves as a digital wallet for securely storing and managing cryptocurrencies. It replaces traditional banking systems, automatically verifying the buyer's land credit history and ensuring transparency and sufficient funds for land transactions. Revenue Office: The Revenue Office manages the collection of Ground Rent, a fee paid to the government for land use. Payments are linked to land transactions for accurate record-keeping.
- c. Surveyor: A surveyor assesses and measures land dimensions, providing reports to NAGIS for record-keeping and documentation.
- d. Legal Office: Integrated into the blockchain system, it maintains comprehensive transaction records to facilitate fair and efficient resolution of land disputes.
- e. Governor's Office: Responsible for endorsing and issuing certificates of occupancy, providing legal recognition and finalizing the land acquisition process. User participants: Buyers and sellers directly involved in the framework, including authorized representatives acting on behalf of the property owner.
- f. Seller: Sellers create an account, upload ownership documents, settle charges, enable land for sale, review buying requests, and approve or reject them.
- g. Buyer: Buyers create an account, deposit funds, submit buying requests, undergo verification and approval by NAGIS/Paramount ruler, make payments including ground charges, receive automatic ownership document transfer, and request the governor's consent for a certificate of occupancy.

A. Framework for Land Registration Management Using Blockchain

The framework for a blockchain-based system model for land registration management solves key challenges in the domain of land registry. It addresses land authenticity verification by involving local community leaders for accurate verification. The framework enhances transparency and accountability by adding permission members to access and document all transactions. It leverages blockchain technology for efficient and secure land registration. The Nasarawa Geographical Information System (NAGIS) governs the platform's technical aspects. A blockchain wallet replaces traditional banking systems, ensuring transparency and eliminating insufficient funds risk. The Revenue Office oversees ground rent collection and links it to land transactions. The Legal Office maintains transaction records for dispute resolution, and the Governor's Office provides endorsement and issues certificates. The framework streamlines the selling process for sellers and enables buying requests and ownership transfer for buyers.

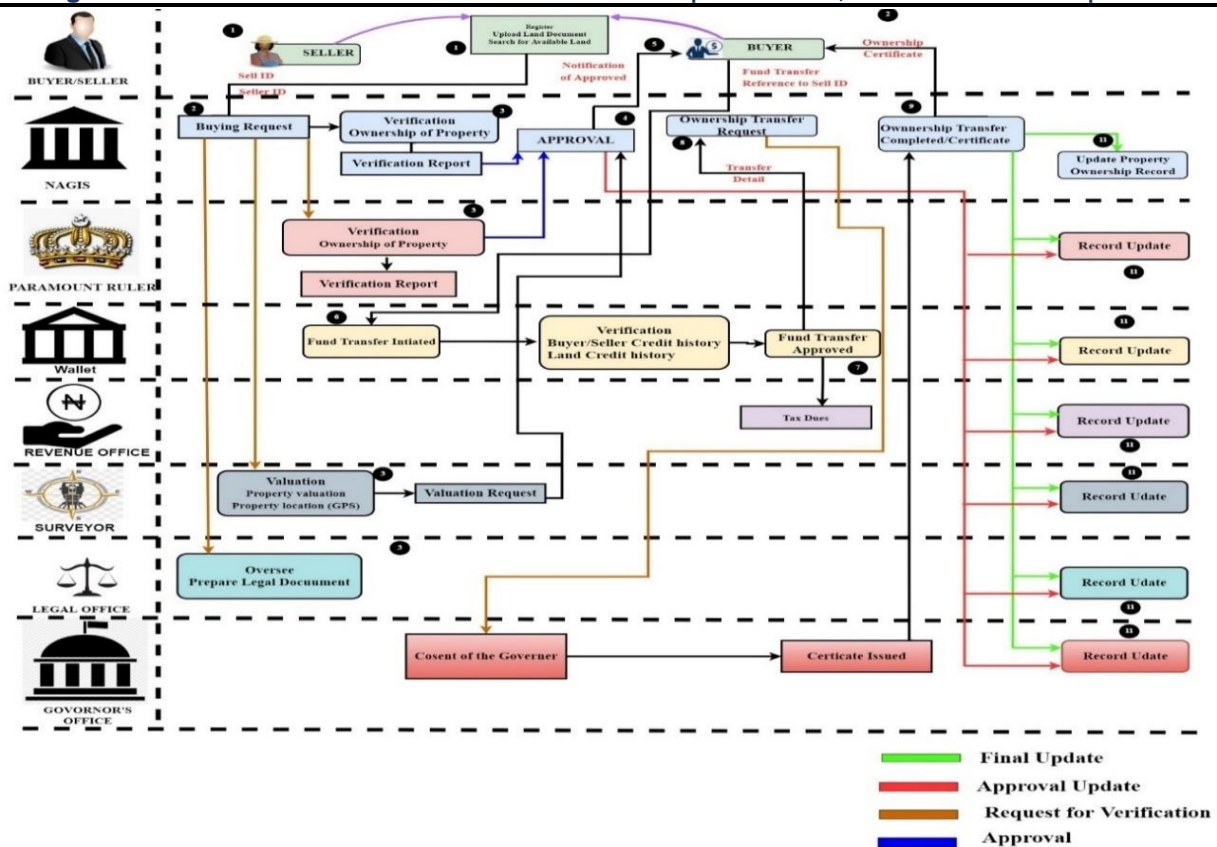


Figure 4. Framework for land registration management using blockchain.

V. Conclusion

With the use of smart contracts in blockchain technology, worldwide transactions are occurred in a more secure viewpoint, because all transaction details are stored in the decentralized server, which means the data is stored in multiple nodes, where misuse of information is nearly impossible. Ethereum block is used to store all transactions details which occurred in the form of bitcoins and also smart contracts. Third-party involvement is completed avoided and there will be no forged documents since the administrator is going to upload all registered documents. A registered buyer can easily know the complete information of the property if the land has any litigate issues, so frauds occurring can be avoided and security is achieved.

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