

Land Registration Management Framework Using Ethereum Blockchain

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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.

Keywords: Decentralized, Ethereum Blockchain, Land Registration Platform, Smart Contract SHA Algorithm.

1. INTRODUCTION

Blockchain technology is productive, it had significant growth from the past few years. Blockchain technology can be widely used in multiple regions finance, land registry, sensor networks, and IoT [2]. It is originated from the kernel of the component Bitcoins. Currently, individuals have to carry hard cash or need to do the online transfer which may lead to transaction frauds if a single digit in the account number is misplaced. Since a huge amount of data is being exchanged, providing security will be an increased task. This may lead to distrust, corruption, hacking of data, insecurity, and deceit. Such demands made to integrate technologies and lead to the opening out of blockchain technology. The key to solving these problems using blockchain technology is by encrypting the information and thus storing it in distributed ledger or data which is decentralized and provides transparency of information [3].

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In Blockchain Technology, a digital currency called Bitcoins or Cryptocurrency is used for transactions. Due to the advance of digital currency security can be achieved in financial transactions. These technologies and techniques are centralized and owned by authorities. Every country follows its government rules, to transfer the land or property to other individuals. These days' frauds are more inland registration because tracking the details of property like who owns the property, rate of the land, single owned or multi-owned property, and does it has any wrangle issues are difficult tasks. And more importantly, the third party is involved where they may quote a high price or else time-delay in the registration process [3]. So, to avoid all issues or frauds we are implementing a land registry platform by using blockchain technology [3].

On this note, a concept called smart contract is used in blockchain technology which is a self-agreement encapsulated code in a system. This code contains a certain set of rules to be followed by the involved individuals in the land registration process and further procedure will be continued if smart contract conditions are met. This smart contract will be automatically activated if conditions specified in the contract are met. This will help to stamp out the need for a third-party person and the registration process will be faster and more efficient.

Thus, a smart contract is placed in a decentralized server. By decentralizing, these contracts are not controlled by any party, but they will be distributed in a shared database run by many systems. Thus, none of them will have control over the data, which means it is near impossible to hack it [3]. Suppose the hacker need to misuse the data they need to attack blockchain blocks or smart contract block where it is stored. To get that information they need to access more than half nodes to get information. Smart contracts will then run securely and instantly, without anyone being able to modify them.

Along with a smart contract, Ethereum is also used because transactions that occurred as bitcoins details have to be stored securely [4]. So, these documents are also stored in Ethereum blocks where the smart contract is also stored. Since this is also stored in the decentralized server, security is achieved for the transaction. Ethereum based smart contract is developed using the solidity programming language. SHA256 hash algorithm is used to generate unique hash values for each block where all bitcoins transaction details and smart contract is stored.

2. 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].

When we look at the examples of the Blockchain-based land registration, it is seen that the applications in Brazil, Honduras, and Sweden come to the fore. US-based Blockchain technology company Factom has developed a Blockchain-based land registration solution for Honduras. Honduras' application is the first application to use Blockchain technology for land registration. The main reason why the Honduran government wanted to switch to a Blockchain-based land registration system was that it wanted to prevent irregularities in the land registration. For this reason, they made a radical decision and agreed with Factom to implement a Blockchain-based system. The system was operated for 3 months starting from November 2015

Brazil, which carries out the ownership transfer in 13 steps, is another country that has switched to the Blockchain-based land registration system. In addition to reducing costs and irregularities, the Brazilian government decided to use Blockchain technology to ensure accuracy, transparency, traceability and high security in transactions, and a solution developed by Ubitquity was put into use in Rio Grande do Sul Province in May 2017. When the data obtained as a result of the system, which was operated for a period of 3 months, was evaluated, it was seen that the errors in the recording system decreased and an important convenience was obtained in archiving [15].

Almost all of the authors talk about how blockchain-based land registration management or land titling management system model was developed in other 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.

2.1 Current Challenges

These days fraud is accomplished in any transaction. Tracking the details of property like who owns the property, rate of the land, single owned or multi-owned property, does it has any dispute issues are all difficult tasks. The challenges that are existing in the present land registry are [9]

- a. The increasing number of fraud cases: There have been several cases of imposters posing as the seller of a property. If an imposter successfully pretends as a property owner, they may receive the full amount after completion and escape with the funds. In many of the cases, both sellers and buyers were unaware of the fraud until discovered by the land registry as part of a spot check exercise.
- b) Time delays: It may take several months to complete the land registration. Suppose if the land has any litigated issues, then that leads to a court battle between parties.

- c) Traceability: In some countries, through paper documents, you can only know the current owner. It does not allow us to find out who else owned that land before.
- d) Human error/intervention: Currently, updates to the land registry records are made manually and the accuracy of those changes depends on a particular individual. It means that the land registry is more vulnerable to human errors. Human intervention can increase the chances of errors in the land registry system.

3. 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 architecture is shown in Figure.1

Suppose the property is already registered and owned by a particular owner, those details will be stored in the registry platform means a decentralized database by the land administration person, and it is placed in the form of blocks in the blockchain. Thus, the admin gives a created land ID to the owner so that a particular owner can access the details of the property [9].

3.1 Land Registration Management Framework

The framework solves many problems in the domain of land registry data mostly kept in a centralized database. A consortium blockchain comprising of land administrator, seller, and buyer as the participant. As the land registry data are subject to the privacy of the government, public blockchain is avoided. The smart contract-based solution has been placed to solve the problem. The seller and buyer are directly involved in participating in property transactions like adding new property and selling partial or complete property, and ownership transfer of properties is made automatically after the payment. The title deed document is stored in IPFS after execution of the smart contract and committing to the ledger a copy of the document is saved in the local database. The model is directed to archive information security, privacy, and integrity using cryptographic techniques inherently existing in blockchain technology during land transactions. It also solves the problem of a single point of / failure.

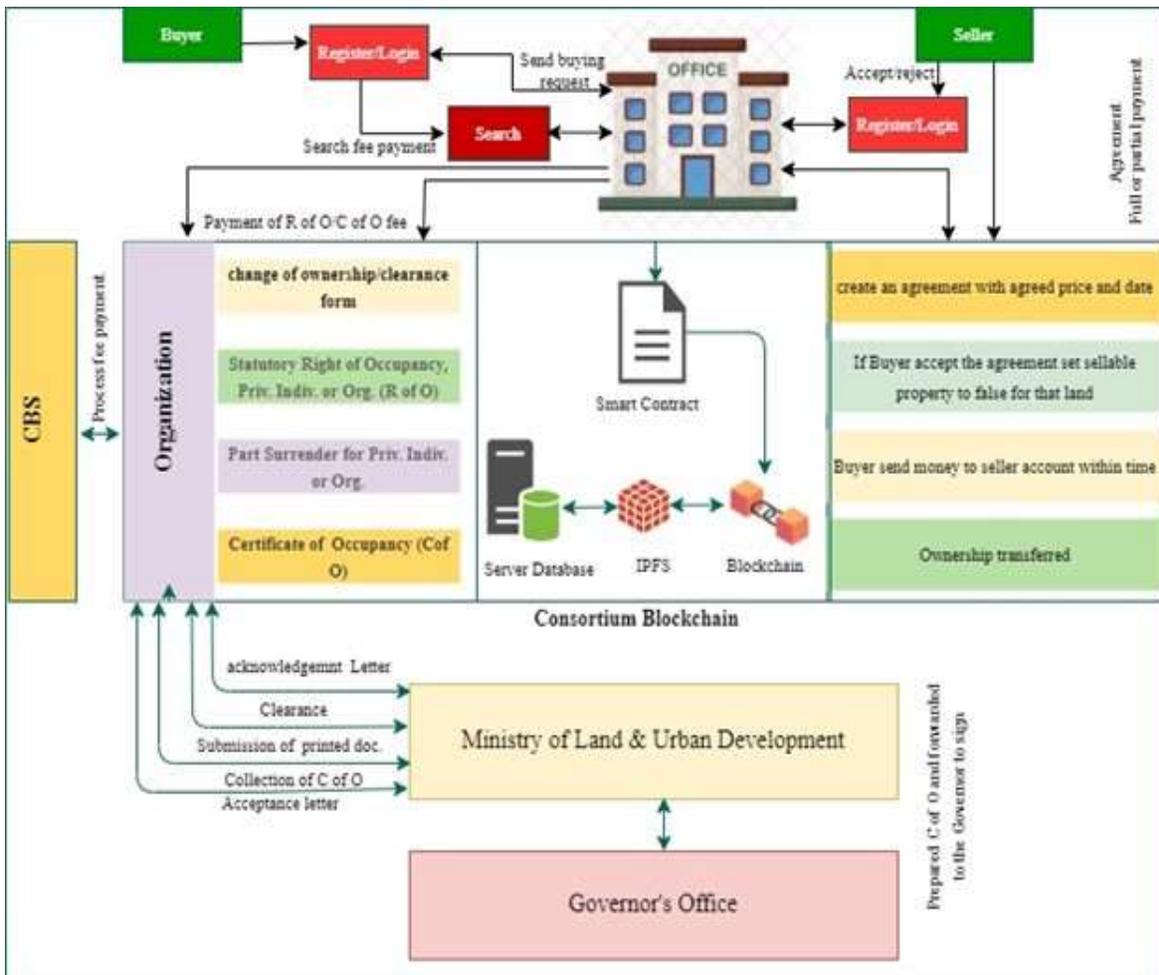


Figure 1 Land registration management framework

Land Office: Here land registry authority is providing the primary services of adding new property registration, transacting the property, issuing deed title, providing information on property details, and ownership details, and verifying the land details and land ownership details.

User Participants: Any seller and buyer are direct user participants in this framework. Sometimes the buyer or seller may not be the actual owner of the property but maybe the authorized representative of the actual owner.

3.2 The System Architecture

The architecture of an application defines how different parts of the system are organized and logically connected. Here the design principles of layered architecture are adopted which are used to design effective implementation deployment of the blockchain applications and the smart contracts scenarios. Blockchain is a decentralized distributed ledger the application layer is comprised of smart contracts, chain code, and DApps where transactions are arranged in blocks, and placed in a Peer to peer network the other layers. Ensures that nodes can discover each other and can communicate, propagate and synchronize with each other to maintain the valid current state of the blockchain network.

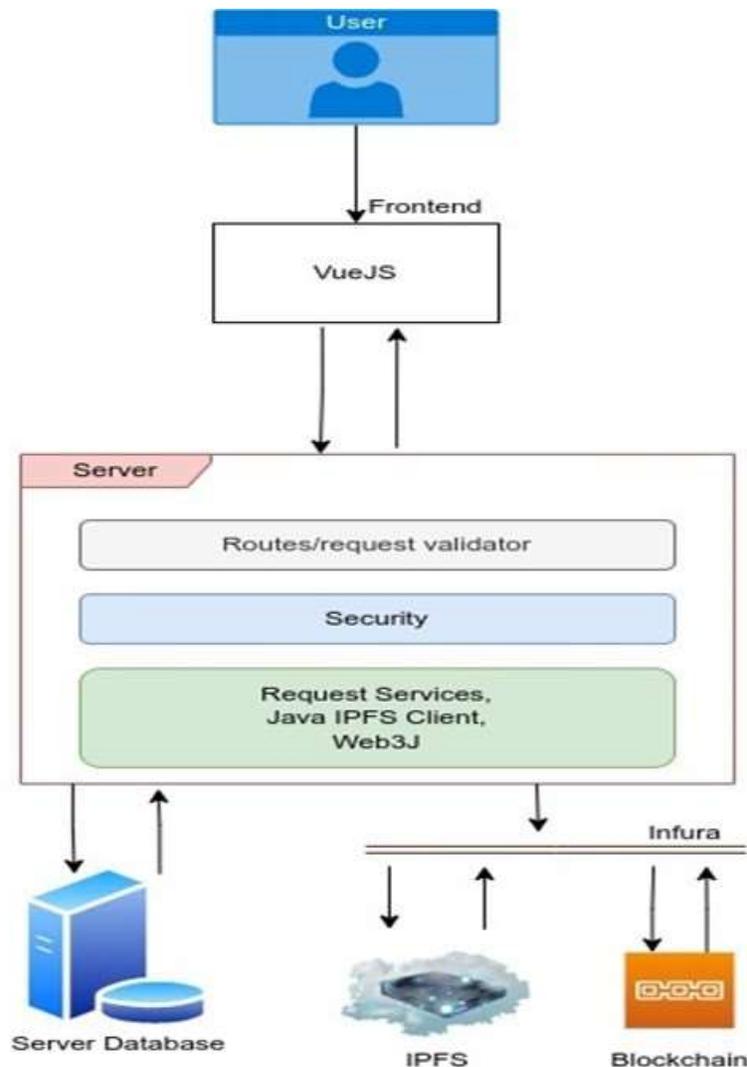


Figure 2: An Overview of the Proposed Architecture

The user interacts with the system using the frontend (built with VueJS) by sending requests to the server.

Server

The routes/request validators check and validate URLs and requests. The security layer checks and verifies whether the client (user) should have access to the resource or not. The last layer performs the request's operation. It uses the Java IPFS client to store and retrieve files on IPFS through an IPFS and Ethereum service provider (Infura). Similarly, it uses the Web3J Java library to perform the transaction on Ethereum through Infura

3.3 Land purchasing and registration system model

Figure 2. Show the smart contract to be used for the land purchasing process. The buyer has to register and login into the system, and search for the registered land for sale along with the seller's address and phone number to contact with.

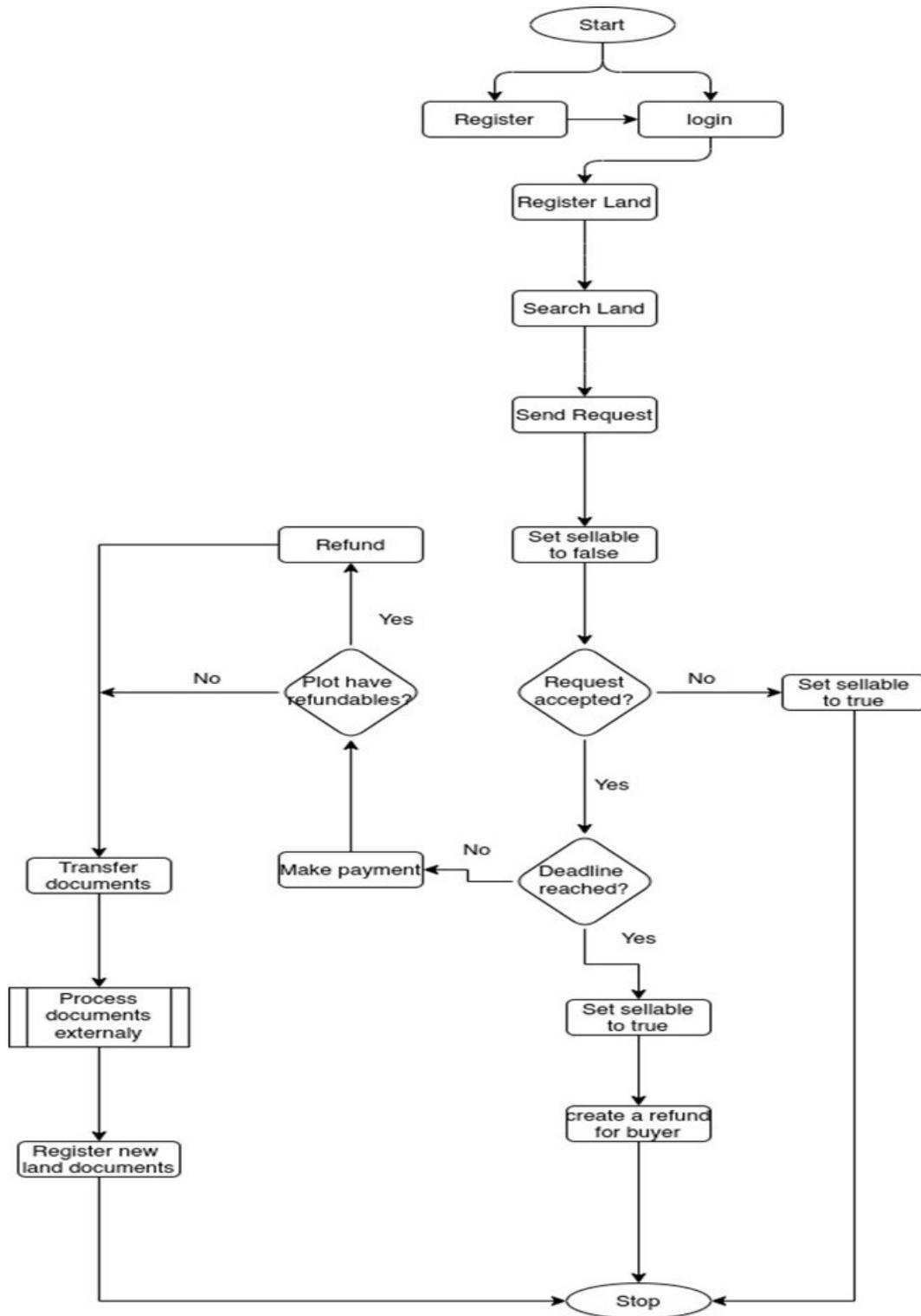


Figure 3: Workflow of the blockchain for land registry

The buyer and the seller must agree to each other's terms and conditions in real life and should settle for a price. If the buyer can pay the total amount and registration fee at the registration time then the process will continue. Otherwise, they set a pledge for partial payment and set a date to complete the pending balance. They should communicate with the land office after setting the price. The land office verifies the documents related to the property. If the seller has legal ownership, the land office logs into their account and creates an agreement with the pledge and the rest of the money (convert automatically to land currency) with two different dates since the buyer can't complete a full transaction at a time. If he/she can pay the total amount at a time then the pledge is set to zero and the rest of the amount will be set to the price amount with the date.

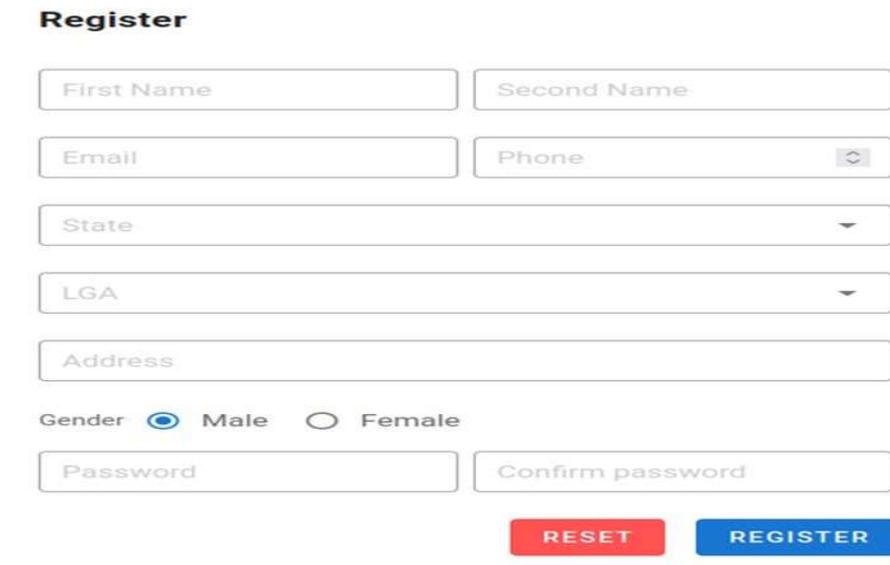
The seller has to agree to the pledge through his/her account. When he agrees to the pledge, the property's sellable field will be set to False and it can't be sold while this agreement is alive. If the buyer accepts the pledge, he/ she has to pay the amount within the fixed date.

To pay for this money, he/she has to go to the land office and buy the land currency. When this currency is paid to the seller, the seller can't cash that until the total price of the land is paid. This currency is kept secured in Government Land Purchasing Account against the agreement which is the 3rd wallet account. If the buyer failed to pay the pledge money during the given time frame, the sellable field of the land will be set to True and the agreement will be void. When the buyer completes the pledge, a new contract is created with the rest of the money and a new date, and the registration process restarts. Later ownership of the land is handed over with the new agreement. Otherwise, pledge money will be redeposited to the buyer's account and buyable property will be reset to True

Whenever a blockchain is incorporated into a new blockchain transaction or some new block is added to the blockchain means several nodes are required to execute algorithms to evaluate, verify, and process the blockchain context within the same blockchain implementation. The new block of blockchain transactions will be accepted into the ledger when most nodes authenticate the block's history and signature, and the new block with data will be added to the database. If a consensus is not achieved, they refuse to add the block to the blockchain. This distributed consensus model allows blockchain to operate as a distributed ledger, without any central or unifying authority having to authorize blockchain transactions. So, the transaction is highly secure in the blockchain [9].

4. RESULT

A new buyer who wishes to purchase land has to register themselves for the land registry platform, by providing complete information that has been mentioned in the form. After successful registration particular ID will be given to the new user, as referred to in Figure 3.

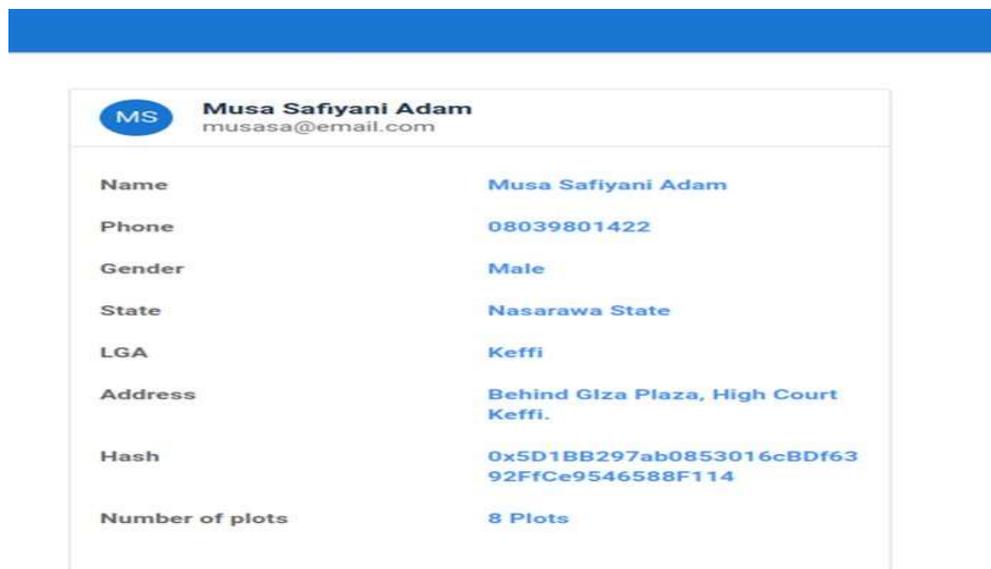


The registration form is titled "Register" and contains the following fields and controls:

- First Name (text input)
- Second Name (text input)
- Email (text input)
- Phone (text input with a dropdown arrow)
- State (dropdown menu)
- LGA (dropdown menu)
- Address (text input)
- Gender: Male Female
- Password (text input)
- Confirm password (text input)
- RESET button (red)
- REGISTER button (blue)

Figure 4: New Buyer registration form

Administrator after storing all property documents in the block and then generates a unique hash value and adds the digital title to this block to make the search easier for the property searcher as referred to in Figure 4.



The interface shows a user profile for Musa Safiyani Adam with the following details:

Field	Value
Name	Musa Safiyani Adam
Phone	08039801422
Gender	Male
State	Nasarawa State
LGA	Keffi
Address	Behind Glza Plaza, High Court Keffi.
Hash	0x5D1BB297ab0853016cBDf6392FfCe9546588F114
Number of plots	8 Plots

Figure 5: Hash value generation

A buyer after getting an id, can log in to the portal and perform a search operation by specifying the title of the property and sending request access as referred to in Figure 5.

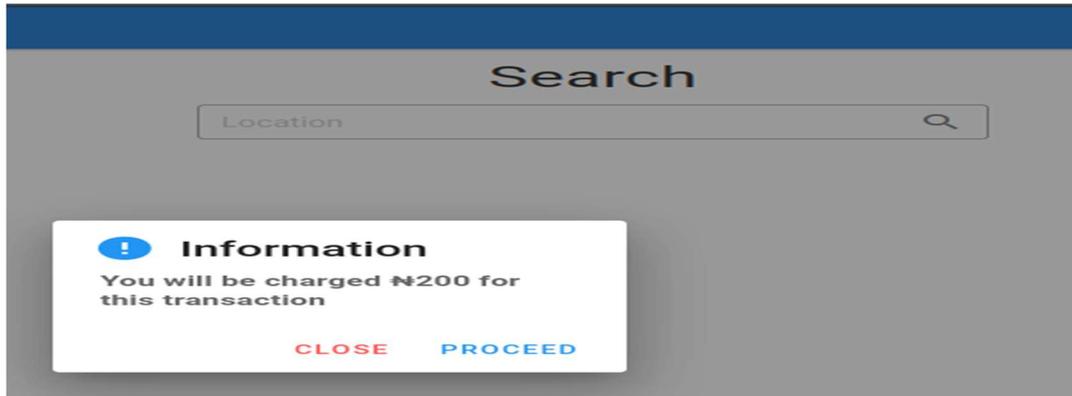


Figure 6 search button

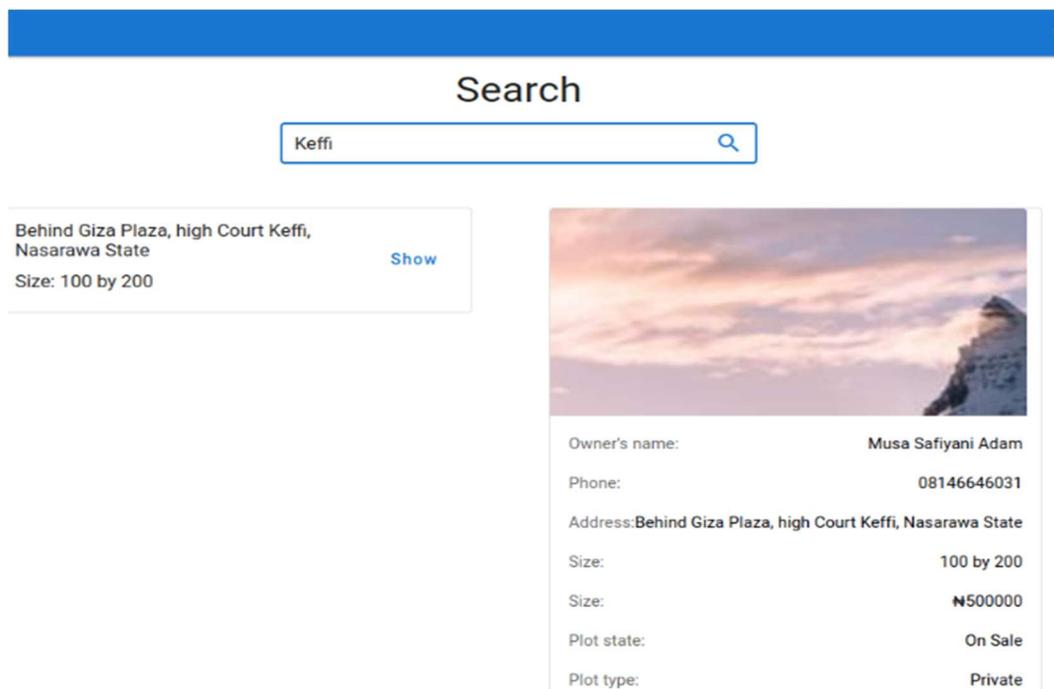


Figure 7: Buyer can search for Property

Since blockchain is decentralized, immutable, it reduces the frauds occurring in land registration as a third party is not involved here and the purchaser can view the documents directly. Since documents are uploaded to block by the administrator there will be no forged land documents. There is no time delay in the registration process as soon as the quoted price is exchanged in the form of bitcoins, updated registration docs will be updated in a

block. These transaction docs are stored on the Ethereum block where the smart contract is stored, so provides security to the data.

5. 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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