Land Administration and Registration System using Blockchain Technology

A Project Report Submitted

in Partial Fulfilment of the Requirements

for the Degree of

BACHELOR OF TECHNOLOGY(HONOURS)

in

COMPUTER SCIENCE AND ENGINEERING

by

RAVINDRA THALARI

(Roll No.2016BCS0029)

to

DEPARTMENT OF COMPUTER SCIENCE

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY

KOTTAYAM - 695017, INDIA

April 2019

DECLARATION

I, **Thalari Ravindra** (**Roll No: 2016BCS0029**), hereby declare that, this report entitled **"Land Administration and Title Registration System using Blockchain technology"'** submitted to Indian Institute of Information Technology Kottayam towards partial requirement of **Bachelor of Technology(Hon)** in **Department of computer science** is an original work carried out by me under the supervision of **Dr. Panchami** and has not formed the basis for the award of any degree or diploma, in this or any other institution or university. I have sincerely tried to uphold the academic ethics and honesty. Whenever an external information or statement or result is used then, that have been duly acknowledged and cited.

Kottayam - 695 017 **Ravindra Thalari**

April 2019

CERTIFICATE

This is to certify that the work contained in this project report entitled **"Land Administration and Title Registration System using Blockchain technology"** submitted by **Ravindra Thalari** (**Roll No:2016BCS0029**) to Indian Institute of Information Technology Kottayam towards partial requirement of **Bachelor of Technology(Hon)** in **Department of computer science** has been carried out by him under my supervision and that it has not been submitted elsewhere for the award of any degree.

Kottayam - 695017
April 2019

(Dr. Panchami)
Project Supervisor

ABSTRACT

The land administration and registration system should be strong to avoid any document forgery, available all the time, and take a short time to complete tasks.The main aim to use Blockchain Technology is to verify the land details.Thus it ensures security and avoids disputes.The architecture of the proposed model is seen with integrated components, there are two modules in the system, one is the digitally signing of land assets and store securely into the blockchain using cryptography algorithms, the other one is verifying the land assets.The system will help in reducing fraud, increase efficiency and in return boost economic growth.

The result shows that the time complexity for the registration/signing and verification of land details to form the system using blockchain is very less and secure when compared to the other traditional land registration system.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Digitalization and the development of new information technology (IT) is one of the strongest forces of change in society. The technology called "blockchains" is one of the most talked about technologies in recent years, both within the IT community, but also within the financial services industry.

1.1 The Land Registry today

Land is a unique asset because it is immovable; its value depends on its location; and with growing population its demand keeps increasing, while its supply is limited. Access to land (or land rights) has a wide-ranging impact on livelihoods, and industrial, economic, and social growth. People with land rights are found to be better off than the landless, due to better access to markets and other economic opportunities that come with such rights.

Land ownership is broadly determined by access to a land title, a document that states such ownership. Having a clear land title protects the rights of the

title-holder against other claims made by anyone else to the property. In India, land ownership is determined through various records such as registered sale deeds, property tax documents, and government survey records.

1.2 Problems in current land registry

system is grappling under fraudsters and people often fear being duped with fake land certificates. Land records in most states date back to the colonial era. The disputes over titles often end up in courts. In fact, over 66 percent of civil cases in India are property-related disputes.

Property disputes and family conflicts clog our judicial system and in a majority of cases, police detain the accused unnecessarily.

According to McKinsey Global Institute, distortion to India's land markets is a barrier to faster growth, accounting for 1.3 percent of lost GDP growth every year.

For any kind of a high value property (real estate, cars, art) it is important to have accurate records which identify the current owner and provide a proof that he is indeed the owner. These records can be used to

- protect owners' rights (e.g. in case of theft)
- resolve disputes
- make sure ownership is correctly transferred to a new owner after sale
- prevent sale fraud

Thus it is crucial to maintain correctness and completeness of this information, and prevent unauthorized, fraudulent changes.

1.3 Solution to prevent the problems

There is no doubt that the problem is daunting. As many as two-thirds of civil cases pending in Indian courts deal with land related disputes, most of which revolve around establishing ownership.

To deal with such crisis, use the technology in managing land records first. Putting India's land records on blockchain would help in reducing fraud, increase efficiency and in return boost economic growth. It will also lessen the administrative hassle of registration and title transfer.

Chapter 2

Literature survey

This paper[6] tells that Forgery of land documents is one of the major problems faced by any state government in land registration system. Even though the documents are now secured in the database, but these records can be tampered because there is no proper security and time-stamping present in the database system. To overcome this problem, the use case can be deployed using Blockchain. Blockchain being a distributed system, data is available to everyone in the network. Every block added into the blockchain is time stamped and proof-of-work is required to add the block, making the data very hard to be tampered.

they have used a private-permissioned Blockchain - Multichain, where the authority lies with the registrar making the process faster because proof-of-work is not required. The implementation of land registration use-case involves recording the documents into blockchain and verifying it with the one stored in digital locker thereby reducing forgery of documents.

This paper tells[2] that the administration of land and property involves a vast array of documents and supporting data.Existing land information systems are typically centralized ledgers (databases) that provide a system of record of a nation's land transactions.A digital repository affords greater capabilities than the paper-based counterpart digitization of paper-based land records adds redundancy and consistency, characteristics of database systems.

This paper tells[3] that Blockchain technology is a distributed ledger technology which helps to store information in a decentralized way. It can be put to use for various purposes ranging from the handling and transaction of virtual currency to maintenance of land registries. The adoption of the technology in India will surely enhance the efficiency and effectiveness of the various sectors. However, certain legal ramifications may arise. The three prominent usages of Blockchain technology are: Bitcoins, Smart Contracts and the Land Registry System.

In this paper[7],the legal ramifications of all the three usages under various Indian laws have been examined. Further, adoption of Blockchain technology in the Land Registry System will require certain structural changes. Therefore, the said structural changes have been examined and certain suggestions have been made for successful adoption of Blockchain technology in the Land Registry System in India.

the land and property rights are at the center of development challenges.According to the World Bank, more than 70 percent of the world's population lacks a

"legally registered" title to their land.Only one-third of countries worldwide track property ownership digitally, which is critical for effective land management.Without formal access to a land registry, people struggle to justify ownership of their own property and thus live in fear of losing their land and the source of their economic livelihood in times of crisis.

This paper[5] tells that a purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network time stamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work.

Across the globe, blockchain land registry programs are in the works. The transparent nature of this technology makes it the perfect fit for use in public records systems. Today, you see a growing number of governments seeking to integrate blockchain into their land registry protocols. Integration makes sense when you consider that blockchain is more efficient, reliable and cost-effective than current models in use.

In this paper[1],the current systems in place are outdated. Keeping track of who owns which pieces of property is difficult when you have hundreds or even thousands of years of land records. It's common to encounter discrepan-

cies within the paperwork including forged documents, counterfeit titles and, in some cases, a complete loss of all documentation. When these situations arise, it can lead to costly court battles between conflicted owners, both of whom believe they are the rightful owner of a particular piece of property.

This paper tells[10] that blockchain is a digital network. It allows digital information to be distributed (on the "distributed ledger"), but not copied. The same information is held across a network of computers – meaning that it isn't stored in one location. This means that the information is less vulnerable to corruption or to human interference or error. Every computer on the network has to accept every new addition of a new piece of information (or "block") to the chain.

In this paper[9],The benefits of blockchain in terms of secure asset tracking are clear so it's no surprise that it is being considered as a possible solution to some of the issues with the current land registration system.

The use of blockchain in land registry is primarily being explored for its potential to enable the "almost instant" transfer of property securely. With smart contracts enabling self-execution when certain conditions are met transactions could be completed faster. For example, a rule could be put in place to facilitate the title of a property being automatically transferred to the new owner when they deposit funds to the appropriate account.There is also the potential for the registration gap to be removed. The use of smart contracts would speed up the process by automatically updating the ledger, instead of buyers having to transfer ownership through an application form.

In this paper[8],Land registries are successful when trust is ensured between all involved parties. In this paper we introduce the idea of improving the quality of land registries by using blockchain technology. With blockchain we can overcome the limitations (e.g. centralization) of the existing land registries and offer a trusted service that provides significant benefits to the participants. This paper also highlights the functionality of a blockchain land registry solution that can be adopted by the Republic of Cyprus and it suggests the implementation of a small pilot that can be used as proof of concept.

This paper[4] tells that India's demonetisation of November 2016 has become a major trigger for the country to move towards digitization and become a cash-free country. Though in their nascent stages, newer and potentially disruptive innovations such as Cryptocurrencies and Blockchain have the potential to replace paper money with digital currency providing a de-centralized and secured environment. Blockchain features such as distributed computing, confidentiality, authenticity, non-repudiation, data integrity, and data availability can help a populous country like India to turn into a cash-free economy.

Blockchain make tremendous impact on the financial sector, particularly in speeding up and simplifying cross-border payments, in share trading, by way of smart contracts, improving online identity management and in loyalty and rewards (Deloitte; 2018). This paper is an attempt to check out some of the blockchain implementations in India done so far in regard to embracing the technology, both within and outside the financials domain.

Chapter 3

Blockchain

3.1 Blockchain

Blockchain is an infrastructure where a distributed digital ledger is maintained by a network of computers or nodes. This means information of a financial or non financial transaction is shared with a decentralized network and validated by the entire network. Therefore, a blockchain framework, not being managed centrally, effectively reduces the chances of data manipulation and leaves lesser scope for a hacker to corrupt one system. A decentralized

computation and information sharing platform that enables multiple authoritative domains, who do not trust each other, to cooperate, coordinate and collaborative in a rational decision making process.

If this technology is so complex, why call it "blockchain?" At its most basic level, blockchain is literally just a chain of blocks, but not in the traditional sense of those words. When we say the words "block" and "chain" in this con-

text, we are actually talking about digital information (the “block”) stored in a public database (the “chain”).

- **Each block will have the following pieces of information:**

Index: To know the block number.
Timestamp: To know the time of creation.
Data: The data inside the block.
Previous Hash: The hash of the previous block.
Hash: The Hash of the current block.

Blockchain technology is not a company, nor is it an app, but rather an entirely new way of documenting data on the internet. The technology can be used to develop blockchain applications, such as social networks, messengers, games, exchanges, storage platforms, voting systems, prediction markets, online shops and much more. In this sense, it is similar to the internet, which is why some have dubbed it “The Internet 3.0”.

3.1.1 The name ’Blockchain’

Blockchain owes its name to how it works and the manner in which it stores data, namely that the information is packaged into blocks, which link to form a chain with other blocks of similar information.

It is this act of linking blocks into a chain that makes the information stored on a blockchain so trustworthy. Once the data is recorded in a block it cannot

be altered without having to change every block that came after it, making it impossible to do so without it being seen by the other participants on the network.

3.2 History of Blockchain

The first recorded mention of blockchain technology came in a document, or whitepaper, published in 2008 by the mysterious founder or founders of Bitcoin, only known as Satoshi Nakamoto. Speculation about the true identity of this undeniably brilliant coder has continued to this day, with Nakamoto claiming in early correspondences to be a man living in Japan, born on 5th April 1975.

It is also worth knowing that Satoshi Nakamoto did not build every aspect of blockchain from scratch. In fact, none of the technologies used in blockchain were particularly new and had been around for several years. However, it is when they are used in combination with one another that they create the revolutionary offering that is blockchain technology.

3.3 The basics of Blockchain Development

- **Blockchain**

The blockchain is an incorruptible chain of blocks where each block contains data of value which is validated by all nodes in the network, not by any central authority. Each block in the chain includes its hash value and that

of the previous block which acts as a unique fingerprint so that no one can tamper with data stored in it.The information stored on the blockchain can never be deleted or altered. Instead, a new block needs to be added to the chain to update the information.

- **Decentralized**

A blockchain is said to be decentralized as it is not stored in one place and does not have a center. Instead, the data saved in blockchain is distributed across many different computers, called as nodes. Since no single entity has control over the data, users interact with each other directly without the involvement of a third party.

- **Smart Contracts**

Smart contracts are the building blocks for blockchain based applications. The concept behind smart contracts is the contractual governance of transactions between two or more participants. It can be verified programmatically with the blockchain, instead of a central authority.Also, smart contracts allow users to control ownership by offering controlled data disclosure.

- **Mining**

Mining is defined as the process of adding or validating transactions to the distributed ledger. It mainly involves creating a hash of a block which cannot be forged. As a result, it protects the integrity of the entire system without needing a central system.Miners are the users who utilize the computational power to mine for blocks.

- **Digital signature**

A digital signature (DS) is the detail of an electronic document that is used to identify the person transmitting data. It is a mathematical scheme for verifying the authenticity of digital messages or documents. A valid digital signature, where the prerequisites are satisfied, gives a recipient very strong reason to believe that the message was created by a known sender (authentication), and that the message was not altered in transit (integrity).

- **Hash**

The groups of blocks which the blockchain miners are charged with must be validated by the system. To do this, the miners must find a password or digital fingerprint that identifies them. This password is called a hash. It is unique, unrepeatable and cannot be modified. Besides, each time a new hash is discovered, it is distributed to the rest of the nodes in the network, so that they are always synchronized.

The concept of taking an arbitrary amount of input data, applying some algorithm to it, and generating a fixed-size output data called the hash.

- One way function
- Even a small change in the data input will result in a very different hash being generated.

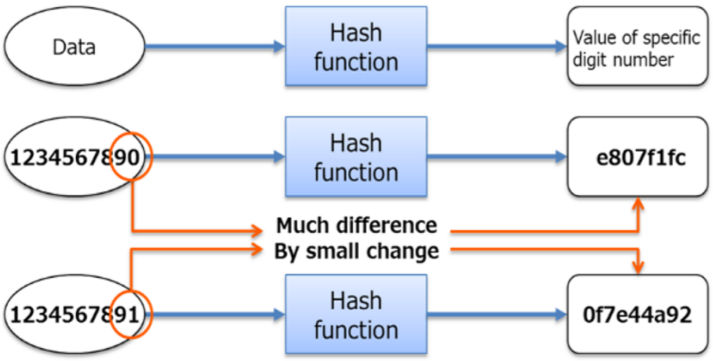

Figure 3.1: The working of hash function

- **Public and private keys**

The Public and Private key pair comprise of two uniquely related cryptographic keys (basically long random numbers).The Public Key is what its name suggests - Public. It is made available to everyone via a publicly accessible repository or directory. On the other hand, the Private Key must remain confidential to its respective owner.

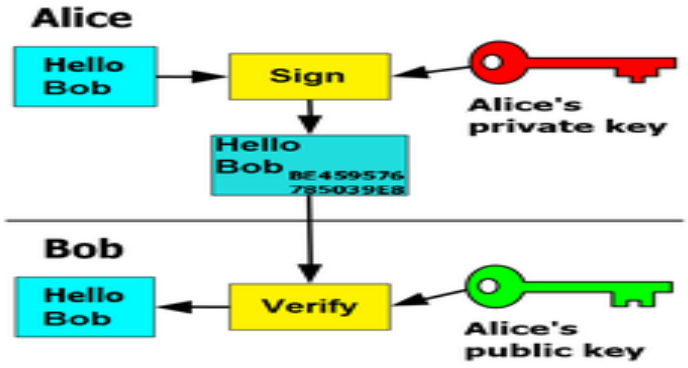

Figure 3.2: public key and private key

Private key/secret key:To generate Digital signature

- **Sign(Message , secrete key) = Signature**

Public key:To verify signature

- **Verify(Message , Signature , Public key) =True / False**

3.4 The blockchain consensus algorithm

- **Proof of Work**

Proof of Work is the first consensus algorithm introduced in the blockchain network. It is used by various blockchain technologies to validate the transactions and add relevant blocks to the chain of a network.As a decentralized

ledger contains all information related to the blocks, it is essential to take care of all transactional blocks.It is the responsibility of miners to manage the transactions blocks which can be done with the process of mining.

The concept behind this technique is to solve complicated mathematical problems and provide the solution.Since it requires a lot of computational power to solve a mathematical problem, proof of work has certain limitations. More a network grows, more the power is required.Firstly, miners have to solve the puzzles to create new blocks and confirm the transactions. The complexity of a puzzle depends on the maximum number of users, overall load and the minimum current power of the network.

3.5 The blockchain development tools

- Remix

Remix is a suite of tools which has been designed to communicate with the Ethereum platform. It is used to debug transactions saved in the Git repository.A developer needs to connect with an Ethereum node to use tools hosted by Remix.Remix is comprised of the following tools

- remix analyzer
- remix-lib

- remix-debug
- remix-tests
- remixd

remix-solidity Remix IDE is a browser based compiler that allows users to develop Ethereum smart contracts with Solidity language. It also supports testing, deploying and debugging of smart contracts.

- Geth

Geth is a command line interface, used to run a full Ethereum node in Go. The tool is designed to implement an Ethereum node in the Go programming language.By installing and executing Geth, a user can perform the following tasks

- Mine Ether tokens.
- Create smart contracts and send transactions on the Ethereum Virtual Machine.
- Transfer funds between addresses.
- Track the block history.

Operating systems such as Linux, Mac, and Windows support the installation of Geth. Also, this command line interface supports two types of installations, i.e., Binary and Scripted.

Using Geth, it can be possible to connect to the existing live blockchain and create its blockchain on the basis of provided settings.

3.6 The top blockchain platforms that support blockchain development

- Ethereum

Ethereum is an open-source blockchain based distributed computing platform founded by Vitalk Buterin in late 2013. Known for executing smart contracts on the custom-built blockchain, Ethereum uses EVM (Ethereum Virtual Machine) to offer the run-time environment.No doubt that Ethereum a permissionless (public) blockchain platform, it is built for mass consumption versus restricted access. It has a native cryptocurrency called as Ether, which is used to fuel the Ethereum ecosystem.

A developer who builds the app on the top of Ethereum platform has to pay in Ethers to execute transactions and run nodes.Since Ethereum uses PoW(Proof of Work) consensus algorithm, its speed is comparatively slower as compared to other platforms.

- **Hyperledger**

Hyperledger is an open source collaborative effort created to advance cross-industry blockchain technologies. It is a global collaboration, hosted by The Linux Foundation, including leaders in finance, banking, Internet of Things, supply chains, manufacturing, and Technology.

- **Ethereum vs Hyperledger**

Ethereum can be either public or private without any permissions whereas Hyperledger is a private and permissioned network.

This means that in Ethereum, anybody can participate in the network at any time. But Hyperledger has a predefined community of participants, and access to the network is restricted only to them. One requires permission to join the network. This mode of participation has a profound impact on how consensus is reached.

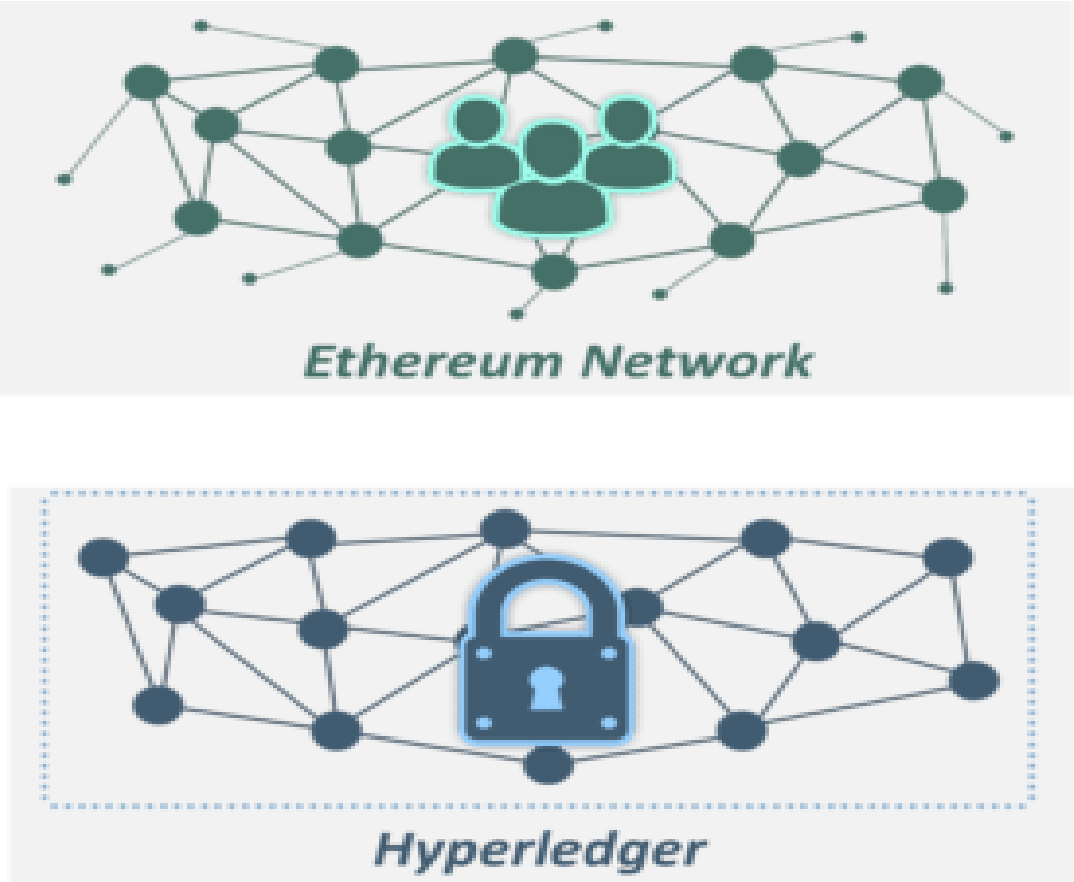

Figure 3.3: Ethereum vs Hyperledger

Chapter 4

Proposed System

Land administration and registration system is the system for storing land information and managing transactions involving land assets.Due to the sensitivity of land issues, land administration and registration system should be strong to avoid any document forgery, available all the time, and take a short time to complete tasks.Thus, this study aims at designing a model for such system based on blockchain technology.

4.1 Design architecture of the model for land administration and registration system

Taking a look at Figure 4.1,the modules in the System are

→ **Land Details Signing**

→ **Land Details Verification**

In order to digitally sign the land assets, the Land Owner has to enter the details such as property id, owner name, address of land and user identification number, the land signing module will take the details and will convert it to a fixed value called as hash, then the hash value will be encrypted with the private key generated by the land owner using cryptography algorithms, the encrypted hash value will be the digital signature, the digital signature along with the property id of land will be kept in the blockchain,it can be retrived for the verification process.

For the verification of land assets, the officials or users has to enter the public key generated by the land owner and all the details required for the land and land owner into the verification module, a hash value(h) will be generated with details entered by the officials, the verification module will take digital signature of land from the blockchain with the help of property id entered by the officials, then decrypt the digital signature with the public key which will be in the module , will be having the hash(h1) after decryption of digital sing. After all, the module will compare the hash values h and h1 to tell whether the land details entered are valid.

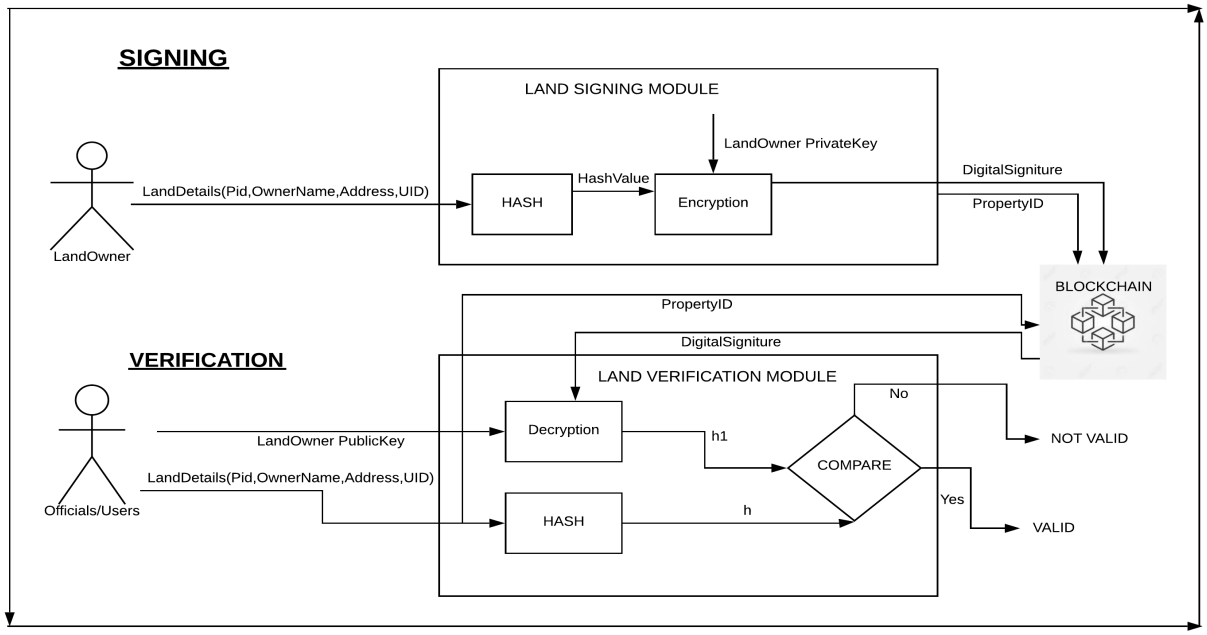

Figure 4.1: Block Diagram of Land Administration and Registration System

Land details signing:

$$h \leftarrow H(PropertyId, LandOwnerName, Address, UID)$$

$$DS \leftarrow E(h, PR_{LO})$$

INPUT TO BLOCKCHAIN : Digital Signature DS, PropertyId

Land details Verification:

$$Step1 \quad : \quad h \leftarrow H(PropertyId, LandOwnerName, Address, UID)$$

$$Step2 \quad : \quad h^1 \leftarrow D(DS, PU_{LO})$$

$$Step3 \quad : \quad if(h^1 == h)$$

$$3.1 \quad VALID$$

$$3.2 \quad else$$

$$3.3 \quad NOT \quad VALID$$

4.2 Implementation

The main aim of my project is to provide security to the land assets by comparing the digital signature present in the blockchain and the digital signature taken from the data entered by the officials.Then check the validity of the land records.

4.2.1 Used programming languages

The computer languages used in my project to develop the UI(user interface):

1. HTML
2. CSS
3. JavaScript

4. jquery

5. Bootstrap

I have used the Ethereum Platform to develop a decentralized application.
The Programming languages used in my project to develop the Back end(Blockchain side) are :

1. Solidity(under Ethereum):used to develop smart contracts

2. Web3.js(a library of javascript)

The Libraries used from JavaScript :

1. crypto-js/sha256 : to generate fixed hash value

2. elliptic : for encryption and verification of digital signature

4.2.2 Dependencies

Dependencies to Develop my first decentralized application are :

1. Notepad(I prefer Visual studio code)

2. Chrome(a browser)

3. Remix IDE:Browser based or online IDE to get instant feedback for solidity code.

4. Ganache : It provides a local server with 10 different addresses containing 100 ether per each .

5. Metamask : it is a cryptocurrency wallet, it works like a bridge between normal browsers and the Ethereum blockchain

We pay the miners with something called Gas, which is the cost to run a contract. When you publish a smart contract, or execute a function of a smart contract, or transfer money to another account, you pay some ether that gets converted into gas.

4.2.3 Wallet

Wallets are very important part of a smart contract. It serves 2 purposes:

- It serves as client to ethereum wallet. To make a transaction on network ether has to be spent and you can authorize these payments using this.
- To communicate with a blockchain and to deploy, you need to either have a full node or a wallet cleint of the network. A wallet can facilitate the communication with the network.

4.2.4 Deployment

The contracts are written in solidity codes and these are to be compiled to get the Application Binary Interface (ABI) codes. ABI is the interface between two program modules, one of which is often at the level of machine code.

To deploy a contract the following steps are to be taken:

- **Compile the code and get necessary ABIcode.**
- Make a deployment with a wallet address as transaction sender.
- Authenticate the transaction form the wallet and pay the transaction cost.
- Your contract will be deployed and will be assigned a public address which can be used to access it.

4.2.5 Web Interface

A web app can be used to work with the contract. A backend javascript framework, web3.js, can intract with the blockchain. It can connect to the network, identify the contract and perform transactions.

The web3js framework works in the following way:

- Connect to a network using 'web3Provider' to a localhost(local testnet) or a global network.
- Create a contract instance using the ABI code and Contract address. Contract address identifies the particular contract on the network to interact with and the ABI code specifies how to access each function.

- Use the instance to call contract functions like javascript.

4.2.6 Steps

1.Open Index.html and then Login with LoginID:ravindra ;password:ravindra123.
2.Now you could add property ID and digital Sign to the Blockchain.
-For that you should do the following steps one by one:
1.open https://remix.ethereum.org/.
2.Copy storehash.sol from contract folder and paste it on remix editor.
3.Compile the program with version 0.4.18+commit.
4.Open ganache server ,It's default port is 7545 with localhost,then in the run bar you have to change the Environment to 'Injected Web3' and connect the metamask chrome extension to http://localhost:7545.
5.Deploy the Smart contract by clicking on deploy.
6.Copy the address of deployed smart contract and paste that address in the blockchain.html JavaScript tag and also in the validity.html JavaScript tag.
4.Enter all the corresponding details in order to load that digital signature into blockchain.
5.Now the officials can validate land with the help of Land Administration bar.

The figure 4.2 tells that we have setLandDetails and getUserInfo functions which are used to load and get the Digital Signature into the blockchain respectively.

At figure 4.3, the user must login in to the system using his/her user creden-

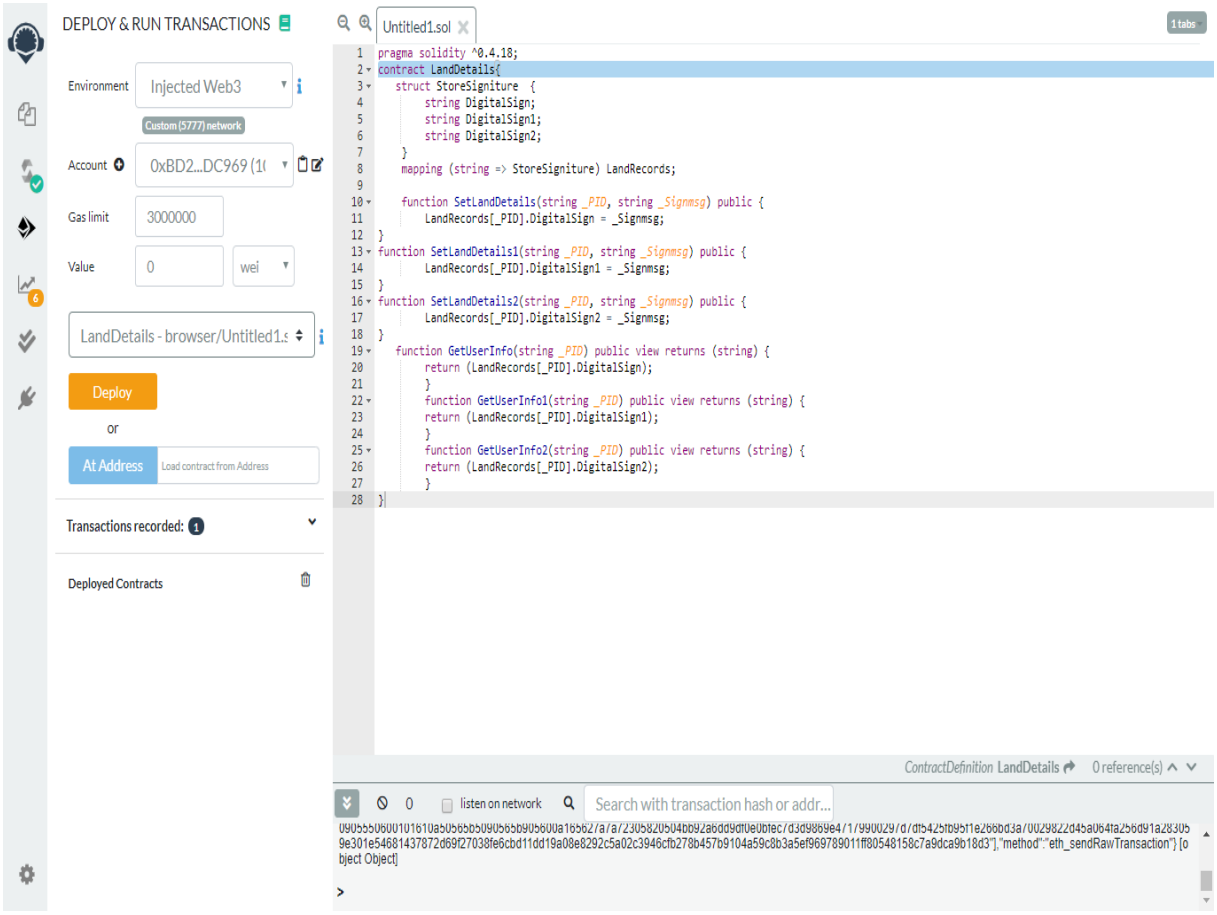

Figure 4.2: smart contract after deploy

tials in order to enter into system.If he/she enters wrong credentials , a pop up would show to represent the Invalid credentials.

At figure 4.4 , In order to validate the land information , first user should load the property ID and Digital sign generated from the land details entered by the user into the blockchain using user Interface.

At figure 4.5,the module validates the land information.

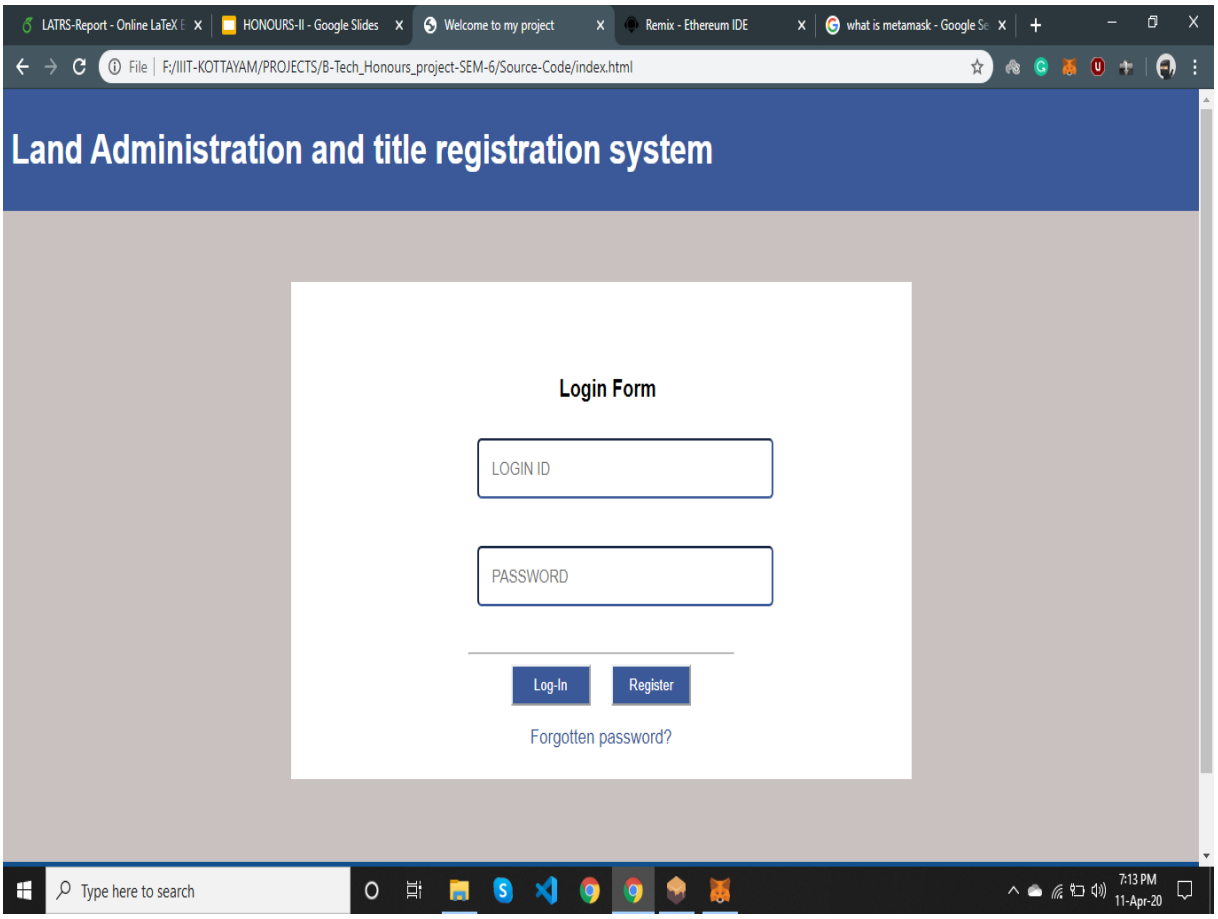

Figure 4.3: user login page

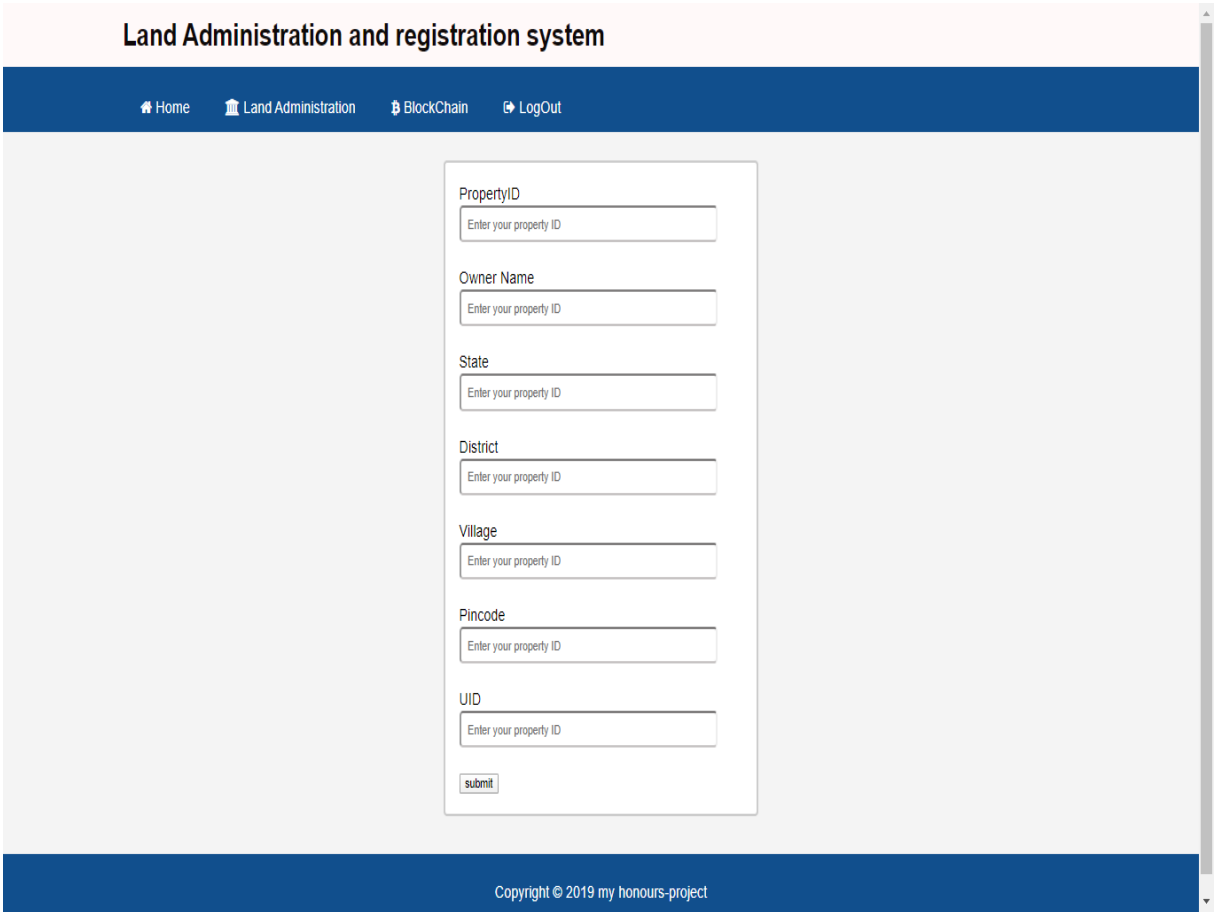

Figure 4.4: load property id and digital sign

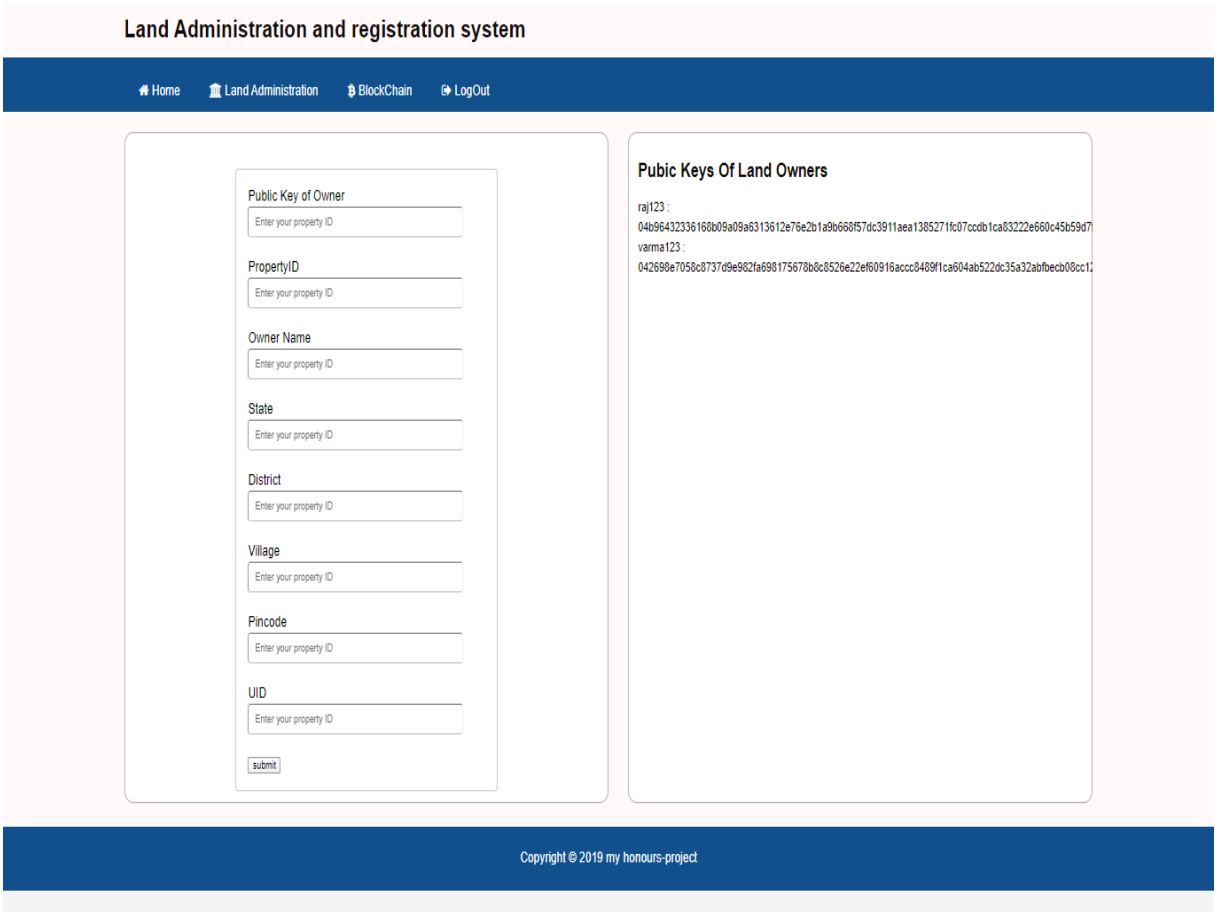

Figure 4.5: check the validity of land records

Chapter 5

Results

The land administration and registration system mainly focuses on validity of land records.The Land owner first sign the land assets by entering the corresponding land details .After that owner could move to load the Digital Sign along with property ID into the blockchain in order to authenticate.Then User could validate the land information by comparing Digital sign generated with the land details entered by the user and Digital sign from blockchain with property id.

5.1 Execution Time Analysis

The functionalities used to verify the land details requires time for execution, there are various functions used in the process of developing application as mentioned in the architecture.

In order to sign the land information, we need to convert the details to fixed hash values, and for encryption and verification of hash values, key pair generation is needed, after all we have to keep the Digital Sign into blockchain and we have to get the Digital Sign from blockchain.Here, I provided the time taken for each and every operation used in the project below.

Function	**Time taken**
Key Pair Generation	9.895 milli seconds
Convert To Hash	2.834 milli seconds
Encryption of Hash	21.739 milli seconds
keep the Digital Sign into blockchain	240.490 milli seconds
Get the Digital Sign from blockchain	213.755 milli seconds
verification of Hash values	50.259 milli seconds

Chapter 6

Conclusion

Having the system which is able to prevent its data from unauthorized changes it is advantageous to the land administration and registration process. This system will be able to solve conflicts in the society which are caused by one land plot having more than one owner. The system will be able to prevent corruption because the individuals who were able to make changes without been noticed it will be difficult for them to do that again.

The system which has the capability of providing self-notarization in title registration process has the advantage of eliminating the number of days which were used for notarization in the issuance of land titles. This can eradicate the time of forty days recommended by Land Rigistry to just a single day (minutes).

Bibliography

[1] Aanchal Anand, Matthew McKibbin, and Frank Pichel. Colored coins: Bitcoin, blockchain, and land administration. In *Annual World Bank Conference on Land and Poverty*, 2016.

[2] Raquel Benbunan-Fich and Arturo Castellanos. Digitization of land records: From paper to blockchain. 2018.

[3] Akash Santosh Loya. Blockchain technology: Usages and legal implications in india. *Business Law Review*, 39(3):79–83, 2018.

[4] Vijaya Kittu Manda and Aruna Polisetty. Status check on blockchain implementations in india. *Available at SSRN 3265654*, 2018.

[5] Satoshi Nakamoto et al. Bitcoin: A peer-to-peer electronic cash system. 2008.

[6] UM Ramya, P Sindhuja, RA Atsaya, B Bavya Dharani, and SS Manikanta Varshith Golla. Reducing forgery in land registry system using blockchain technology. In *International Conference on Advanced Informatics for Computing Research*, pages 725–734. Springer, 2018.

[7] Qiuyun Shang and Allison Price. A blockchain-based land titling project in the republic of georgia: Rebuilding public trust and lessons for future pilot projects. *Innovations: Technology, Governance, Globalization*, 12(3-4):72–78, 2019.

[8] Marinos Themistocleous. Blockchain technology and land registry. *The Cyprus Review*, 30(2):199–206, 2018.

[9] JACOB Vos, B Beentjes, and C Lemmen. Blockchain based land administration feasible, illusory or a panacea. In *Netherlands Cadastre, Land Registry and Mapping Agency. Paper prepared for presentation at the 2017 World Bank Conference on Land and Povertry. The World Bank, Washington, DC*, 2017.

[10] Zibin Zheng, Shaoan Xie, Hong-Ning Dai, and Huaimin Wang. Blockchain challenges and opportunities: A survey. *Work Pap.–2016*, 2016.