GREEN UNIVERSITY OF BANGLADESH (GUB)

# A Lucid Way of Land Mutation Using Hybrid Blockchain


**Submitted by**

Nawshad Fahim (151002063)

Md. Suzon Mahmud (151002069)


*A thesis submitted to the Department of Computer Science & Engineering*

*for the partial fulfillment of the degree of*

*Bachelor of Science in Computer Science & Engineering*


**Supervised by**

Mr. Md. Ashaduzzaman

Lecturer, Department of CSE



Department of Computer Science & Engineering

Green University of Bangladesh

220/D Begum Rokeya Sarani, Dhaka-1207



October, 2019

# Declaration

I hereby declare that this thesis is based on the results found by myself. Materials of work found by other researcher are mentioned by reference. This project, neither in whole nor in part, has been previously submitted for any degree.

| | |
|---|---|
| Nawshad Fahim | Md. Suzon Mahmud |
| ID: 151002063 | ID: 151002063 |

# Certificate

This is to certify that the thesis entitled **A Lucid Way of Land Mutation Using Hybrid Blockchain** has been prepared and submitted by **Nawshad Fahim & Md. Suzon Mahmud** in partial fulfillment of the requirement for the degree of Bachelor of Science in Computer Science and Engineering on October 31, 2019.

---

Mr. Md. Ashaduzzaman
Supervisor

Accepted and approved in partial fulfillment of the requirement for the degree Bachelor of Science in Computer Science and Engineering.

---

Prof.Dr.Md.Zahidul Islam Ahmed
Chairman

---

Dr.Muhammad Aminur Rahaman
Member

---

Sumaiya Kabir
Member

---

MD. Jahidul Islam
Member

# Acknowledgments

We express our utmost thanks and gratefulness to the almighty Allah for giving us such blessing which helps us to finish our final year Thesis successfully. The research included in this dissertation could not have been performed if not for the assistance, patience, and support of many individuals. We would like to extend our gratitude first and foremost to our thesis supervisor Mr. Md. Ashaduzzaman Lecturer Dept. of CSE for mentoring us over the course of our BSc program. His insight lead to the original proposal to examine the possibility of re-examining the sensitivities of the entire thesis work. He has helped us through extremely difficult times over the course of the analysis and the writing of the dissertation and for that we sincerely thank him for his confidence in us.

We express our utmost gratitude to Prof. Dr. Chowdhury Farhan Ahmed, Chairperson Dept. of CSE, Green University of Bangladesh, Dhaka; for his valuable advises that have encouraged us to complete the work within the time frame. We are grateful to him for his efforts to help me completing the degree of Bachelor of Science in time. Moreover, we would also like to thank the other faculty members of CSE department who have helped us directly or indirectly by providing their valuable support in completing this work.

Finally we would like to extend our deepest gratitude to our parents without whose love, support and understanding we could never have completed this Bachelor of Science degree.

# Abstract

Globally land is the second most important after, life. The number of lands is constant but the number of lives is increasing day by day. So, the market value of land is rapidly increasing as well as land-related complexities and conflicts. We are still following the decades-old methods of land ownership and mutation process. The value of land isn't going to decrease ever, but the security for land authentication isn't transforming at the technologies best. Still we use the analog system in most countries. As a result, approximately 70 percent of civil cases in Bangladesh are based on land-related issues. The investment of land is the most profitable invest and the invested land is one of the most precious elements, so it needs proper security and transparent documentation.

The blockchain is the most growing technology in the 21th century. The blockchain came with the Bitcoin, but it had already shown its capability beyond the cryptocurrencies. There are areas as financial and banking, manufacturing, IoT, energy, media, healthcare, insurance, government projects, and utilities, etc. are using blockchain. After the first launch in 2008 with Bitcoin, blockchain is still immune to any security concern. With the security upgrade blockchain provides a decentralized ledger technology that is Increased capacity, faster settlement and automated anonymous verification features that are very suitable for the management of lands. It's not far that the blockchain will replace most of the networking system in future and, as goes land it's better than the currently existing system.

# TABLE OF CONTENTS

# List of Figures

# Chapter 1

# Introduction

The Bitcoin was the first system that has run the blockchain to protect the system information and work as the backbone of the system. As a cryptocurrency Bitcoin wasn't the first one but it is the most successful one and never faced any kind of issue for using from 2009. Blockchain is a distributed and decentralized record system that cannot be controlled, manipulate or corrupt by anyone.

The land is the most precious and permanent property that one can have. For its size and documentation complexity the landowners are facing a tremendous amount of difficulties. It dedicates especially for those less educated people. Due to the legal complexity, the knowledge required for handling land is way too much for general people. Undoubtedly the correction of law that can overcome the complexity is not a time-efficient work and there is no light of hope for that in near future. There are more, most systems have major security flaws. That makes the options narrower for the replacement of decade old land owing and mutation system. Blockchain has a 100 percent success rate after the invention and still dominating the fileds that it reached. There is no place for misplace and security flaws in block chain and its very much suitable to replace the land owing system.

## 1.1 Overview

People across the globe give importance to two things – life and land. The importance of life is simply understood as it's the entity of one. The understanding of land is a complex one. The number of lands is limited and the competition for land is constantly growing every time. There are land laws in different countries according to their circumstances. But there are always many disputes against the laws that whether the law is capable enough for the persons that are on the land. However, the land law is a bit complicated and it requires certain studies for understanding. For a regular civilian with no study of law, it's a bit complicated to deal with property.

In 2008 an anonymous person or group of person pseudonym as Satoshi Nakamoto invented a cryptocurrency named Bitcoin with a new backbone technology Blockchain. Blockchain is the public transaction ledger that securely retains sets of growing records which is also referred as blocks. Bitcoin is the most successful and widely used cryptocurrency nowadays. The secret of bitcoin relies on blockchain, the most successful technology after the internet. Blockchain is still remaining non-controversial technology that theoretically it is nearly impossible to corruption. The system is so efficient that it can be used for any ledger-based information and communication system[1].

The land ownership documents contents information, the set is mostly numeric. All the data are registered in registration papers with other certifications. These data are also registered in a ledger system at the government archive. We've designed a blockchain system that can be used as the most secured ledger with the benefit of user-friendly accessibility. The goal of the system is to give user most secure but most simple way to mutate their lands with no third-party help.

## 1.2 Problem Statements

Land was never a problem-free topic from the very beginning of civilization. There are the major problems that occurred during our study,

- The first problem is to gather the data. The land is case sensitive and precisely cal-

culated matter. Here we need all the data from all the registered lands in the country. Fortunately, in Bangladesh, the digital registration has already been started. It may be the beginning of the most secure land mutation journey.

- The critical issue is the legal condition. There are many land registrations that are not updated with the latest land laws. So, there needs a major update regarding the landowners.
- Many lands are in a controversial state and included in running cases. This will be the most time-consuming problem to solve.
- The system requires brief knowledge of cryptocurrency and a huge number of manpower.
- The system consumes resources heavily. The major resources are computing machines, electricity, and internet.

## 1.3 Motivation

Owning a land requires also the responsibility to maintain its prospects and government-issued regulation. Mutating land is a bit of stress if there is no previous knowledge. In Bangladesh mostly we use middleman for land mutation. The process is a hassle in cases and often the middleman helps the higher paid parties to get them the best value, it often causes loss to the other party. The middleman uses the knowledge of land laws and the administration rules briefly which is often unknown to the parties. The knowledge is complicated and general parties avoid the advanced study of them, so often they get robbed by the other parties with the influence of the middleman. According to the recent case histories of Bangladesh, almost 80 percent disputes creating backlog in their sub-ordinate judiciary are related to land [2] for the combined result from both Civil and Criminal cases. There is an uncertain number of cases that are caused by land. The most common of them includes documentation fraudulence, possession issue, legacy distribution, etc. and may cause physical, mental and financial damage, loss of

wage and time, loss of social and legal reputation on a temporary or permanent basis. From the perspective of Bangladesh as a representative of third world countries, the latest update of land law, Acquisition, and Requisition Act which has been enacted from 2017. This was the update of The Acquisition and Requisition of Immovable Property Ordinance, 1982 law which has been updated several times. The land is the most beneficial investment and there will be no shortage nor loss to own land. No matter how many laws and law enforcements we have, there will be controversies and every people won't be an honest civilian. There undoubtedly, we have to lack in our land systems and there needs to be improved.

## 1.4 Objectives of our research

Our main goal is to provide the most secure land mutation system in the most user-friendly environment. The main system is way too complicated for the time we have in our undergraduate study and also a matter of huge expense, and study. So far, we've done some of the basics of the system. Here are the objectives of our research,

- Briefly study the land laws of Bangladesh and observe real time registration data.
- Study blockchain and determine which one kind of blockchain is the most suitable for our system.
- Design an architecture of the system.
- Create and develop the portals of the architecture.
- Finding the best possible connections of the system and define them.
- Develop a working version of the system with the use of realistic data.
- Implement all the land data and make it useable.
- Create environment for the whole system.
- Find the flaws and try to solve them.

## 1.5 Contributions

Our research required a higher level of study and knowledge. We've completed some of the objectives of the research. They include,

- Study the latest land laws in Bangladesh and investigate further from land experts as specialized land advocates.
- Study blockchain and identify the suitable one for the land administration and mutation system.
- Design and development of an architecture.
- Develop a representable demo program that can cover our main proposes.

# Chapter 2

# Literature Review

## 2.1 Overview

In this chapter, we will discuss the legal states and conditions of Bangladesh at the very beginning. Then there will be a brief discussion on blockchain. After that, there we've discussed the advanced features of hybrid blockchain as it's the backbone of our proposed system. There will some related works and the surface view of proposed system at the very end.

## 2.2 Introduction to Land Law of Bangladesh

Land can be owned by the individual, the cooperative, and the state under various legislations prevailing in Bangladesh. The land is a fundamental factor for agricultural production and is thus directly linked to food security. So, security of land interest is an important foundation for social and economic development. Besides, securing land rights is particularly relevant to the security of the vulnerable group, e.g., the poor, the women and the indigenous people. This way, through ensuring land rights, social and economic development may be made. Al-though land laws of Bangladesh have a long history, basically, the following Acts and Ordinances, among others, are applicable in Bangladesh in this regard Relevant Laws[3]:

- The Permanent Settlement Act, 1973 (Regulation I)
- Regulation VIII of 1819
- Regulation XI of 1825
- Bengal Tenancy Act, 1885
- Non-Agricultural Tenancy Act, 1949
- Non-Agricultural Tenancy Rules, 1949
- State Acquisition and Tenancy Act, 1950
- State Acquisition and Tenancy Rules, 1951
- Bangladesh Land Holding Limitation Order Rules 1972
- Land Development Tax Ordinance Rules 1976
- Land Reform Ordinance and Rules, 1984
- The Land Survey Act 1875
- The Bengal Tenancy Act 1885
- The Transfer of Property Act 1882
- The PDR Act 1913
- The Survey and Settlement Manual 1935
- The Land Development Tax Ordinance 1976
- The Immovable Property (Acquisition and Requisition) Ordinance 1982
- The Land Reform Board Ordinance 1989
- The Land Appeal Board Ordinance 1989
- The Land Management Manual 1990

Ministry of Law, Justice and Parliamentary Affairs on October 27, 2014, published the new 'Bangladesh Registration Rules, 2014'. It will replace the Bangladesh Registration Rules, 1973. The new rules will become effective from November 16, 2014. Some of the key parts of the new rules:

- The process of maintaining the records.
- Criteria for accepting a deed for registration.
- Process in case of unavoidable delay.
- Rules about commission and visit.
- Rules for handling deed which is filed for registration after the specified time limit.
- Rules for registering deed executed outside Bangladesh.
- Post-registration activities.
- Rules about certified copies.
- Special rules for power of attorney.
- Special rules for will, etc.

### 2.2.1 Condition of latest land law

Firstly, we have analog paper documentation for the land and there are possibilities for paper manipulation. Then we have a time lengthy heretical verification process that has been immersed with corruption and bribe. The land documents are often written by hand and made with such difficult legal terms that are inoperable by a regular person. Then comes the unit, we have some units instead of a universal land unit. This creates great confusion since they contain fractions and often hard to convert. As an example – Some places count 1 Bigha = 33 Satak and some counts 1 Bigha = 63 Satak. Then comes the witness part, there is no validating system to issue a witness. That means

anyone can be a witness. For numerous certain reasons, there is a necessary demand to have a necessary update in the land-related system. The law can be adjusted but it will take decades to update the proper law. Here we propose a completely digital system that will just replace the analog system. The system will protect and represent the accurate data so there will be no chance for dislodge. There will be proper verification by the best record system till now, so no system manipulation nor corruption. There will be no compromising exchange as there will be banks and the government to monitor. Moreover, there will be a single unit and no third party. These are the main flaw points that have been suffocating the land-related system[4].

## 2.3 Introduction to Blockchain

Blockchain is not a certain network or a gadget. It is a decentralized and distributed ledger system that is used to autonomously record and validate transactions across the Internet.

Blockchain is a kind of ledger with some specialties. The data in this ledger is cryptographically linked with each other in a manner that they can not be tempered without tempering the whole system. The data are stored in the set of three elements called blocks. The elements are – previous hash, data, and successor hash. The build of a block is its head contains the hash of the previous blocks' successor hash, then there comes the data, then the successor hash of current block[5]. The blocks maintain a connection between all the hash this way which is called the Hash tree or Markle tree. The concept is simple, the blocks contain user data, that are monitored also by the blocks. If there is an interruption, then the data won't be registered. The system provides the valid users to input data that will then be encrypted with the SHA-256 algorithm and the system will do the rest. The system will then have to send the encrypted data as a block to the blockchain network. The other blocks of the system will then analyze the proposed block and validate it. If it becomes validated, then it will be connected with the respective parent block and become a part of the network. There is an obvious fact that once a block is made, that cannot be erased, destroyed, edited, merged, tempered,

or corrupted. The only thing can be done in order to solve any human-made error is to create a new block. It will keep any kind of change.

### 2.3.1 Types of Blockchain

There are three kinds of blockchains. They are,

- Public blockchain
- Private blockchain
- Hybrid blockchain

A public blockchain is those that allow anyone to join the blockchain as a user. The transactions on the ledger are open to the public on the blockchain explorer. As in **figure 2.1** the blockchain network contains only distributed network and all the users create the strings. It is the biggest and most resourceful blockchain due to its size. For the size it is also the most time-consuming mining of all blockchain networks. The best example of a public blockchain is Bitcoin and Ethereum.

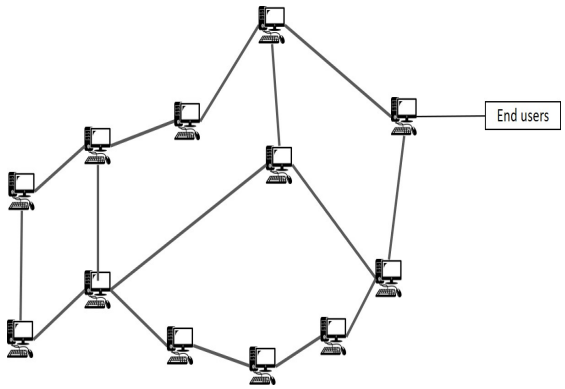


Figure 2.1: Public Blockchain

There is another blockchain that offers transparency, immutability, limited accessibility, and a distributed network while maintaining the full functionality of a fully-fledged blockchain. That's known as the private blockchain. The private blockchain maintains limited access, visibility, and storage capacity to only the special authorized users.

A private blockchain is centralized as in **figure 2.2**. There are many uses of private blockchain as Ripple, Hyperledger, etc.

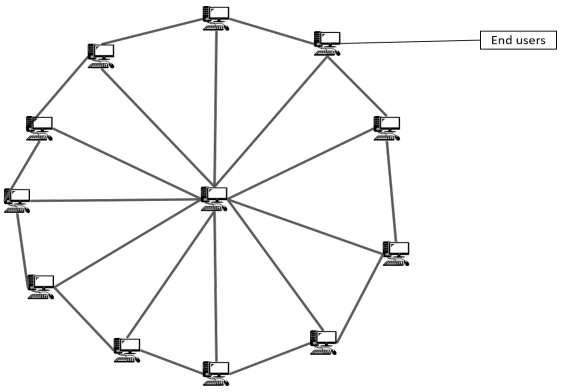


Figure 2.2: Private Blockchain

Hybrid blockchain is distributed and decentralized but it provides the limitation as to the private blockchain for general users with the root-level accessibility to the system authority. There are always two sets of users. One is the general user, one is the authority that may monitor, maintain, and distribute the resolution. As in the **figure 2.3** the network provides authority as the general users with some special powers. TradeFinex which is one of the global leading trade and financial platform uses the XinFin, the first hybrid blockchain.

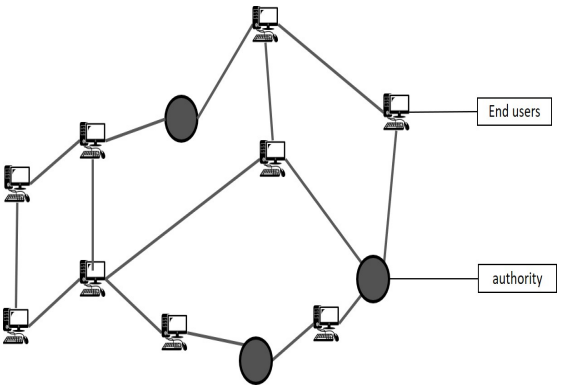


Figure 2.3: Hybrid Blockchain

### 2.3.2 Hybrid Blockchain

Hybrid blockchain is a combination of the private and public blockchain, depending on their architecture. Public blockchains are accessible to and managed by the public. Anyone can participate in the maintenance and governance of the blockchain. The most popular blockchain in the world, Bitcoin, is a public blockchain. Participators are typically rewarded in the form of block rewards for their contributions to the network to incentivize good behavior on the part of network peers. Achieving consensus for a public blockchain is time-consuming and expensive. The consensus mechanism that Bitcoin uses, Proof of Work, relies heavily on wasteful computations for millions of devices to ensure security. By comparison, a private blockchain allows limited access to entities outside a trusted few who were involved in the creation of the private blockchain. Typically, private blockchains have administrators who can control permissions of adding or modifying data on a private blockchain [6]. The most popular private blockchains include the Hyperledger fabric which is being developed as a competitor to Ethereum by IBM and quorum, which is being developed by J.P. Morgan. Private blockchains are much faster than public blockchains because the network is managed by a handful of trusted nodes whose motives are clearly for the benefit of the network. Such trusted nodes typically belong to financial institutions or universities to maintain fairness and remain unbiased.

Each type of blockchain has its strengths and weaknesses. Public blockchains while being transparent and resistant to tampering are slow and expensive whereas, private blockchains are somewhat centralized but can deliver much higher throughput and speeds. As a logical step, hybrid blockchains combine the benefits of both of the blockchains while trying to limit the disadvantages. Therefore, with hybrid blockchains, we can employ a public blockchain to make the ledger accessible to every single person in the world, with a private blockchain running in the background that can control access to the modifications in the ledger.

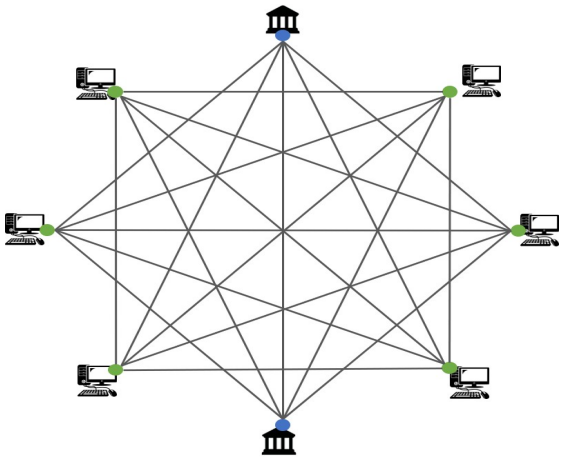

Figure 2.4: Nodes of Hybrid Blockchain

Here, as shown in **figure 2.4** the hybrid network consists of two users, the blue and the green. The blue is the authority and the green are the general users. The inner gray lines represent the connection between different devices. They are connected identically with others despite their privileges. The gray dotted outline indicates the area of the hybrid blockchain network.

Hybrid provides an enterprise-ready blockchain solution that is much better suited to highly regulated enterprises and governments as it enables them to have the flexibility and control over what data is kept private versus shared on a public ledger. Coupled with the operational needs of faster transaction times, security and auditability features that are not suited to public blockchains. Large enterprises want the benefits that blockchain can deliver without the associated risks of a public blockchain. Especially as blockchain is still nascent and evolving. The enterprises have found a suitable blockchain solution that has resulted in the creation of several private-public blockchain-focused projects including R3 Consortium, IBM's Hyperledger and the Enterprise Ethereum Alliance.

### 2.3.3 Security proficiency of blockchain

Blockchain provides the most innately secure protocol ever existed. There are many use cases for security purposes, but here are few described,

- **Denial of Service (DoS):** In the blockchain, a denial of service attack involves submitting more transactions to the blockchain than it can handle. But there are protocols integrated for this in the system. There is a fixed-sized block created at a time in blockchain systems at a fixed rate and are in a distributed fashion. So, it has a maximum capacity that a determined attacker can exceed, rendering the blockchain unusable.

- **Endpoint Security:** In the blockchain, endpoints are the nodes and are completely homogeneous. Heterogeneity can be dangerous because an attacker has more options for finding vulnerability to exploit while homogeneous means that a flaw in one system is a flaw in all of the systems.

- **Intentional Misuse:** In the blockchain, systems using Proof of Work (PoW) incentivize miners to do something a lot but not too much. The main weakness of the Proof of Work is that a blockchain becomes insecure if over half of the mining network's processing power is controlled by a single group. Proof of Work incentivizes miners to control as much processing power as possible to win remarks but doesn't want them to become too powerful.

- **Code Vulnerability:** Anyone can write a smart contract in blockchain and a flaw in the smart contract can have wide-reaching consequences. The only hack to date against the bitcoin network was enabled by an integer overflow vulnerability in the Bitcoin protocol. When exploited, an attacker was able to assign themselves more Bitcoin than was ever intended to be created. If the Bitcoin network didn't 'break the rules' by modifying the historical ledger through a hard fork, Bitcoin would have become worthless. But for the private and hybrid blockchain these regulations are way stricter and even in hybrid blockchain the security is always monitored, so there is no scope of code vulnerability.

- **Data Protection:** Data is distributed and the blockchain relies upon to provide integrity and availability. The blockchain data is stored identically in all the miner server. They are frequently updated and uses the most secure cryptographic hash

algorithms to identify any change. There is no scope to manipulate the data at all the servers at a time. Even if it's possible, there is no option to change the data history. Therefore, the data is secure in any way.

## 2.4 Related Works

The reason for choosing blockchain is obvious. So far, it's one of the best technological inventions after the internet. It has a non-controversial track of history and also it has improved many other fields after the cryptocurrency. Currently, there are numerous researches going on blockchain mostly in security fields. There are researches on blockchain in the fields as banking c[7], healthcare [8], government [9], education [10], voting system [11], etc. For land-related systems, there isn't work to mention. We were researching the IoT security and we've found the similarities in the land registration and mutation system. There are several works on blockchain, we've got architecture wise relatable paper on IoT security and privacy [12], and IOT management [13]. Our topic was privacy and security-sensitive one, we opt to choose the principles as decentralized privacy method [14]. There was not much work on the hybrid blockchain. The proposed system requires the digital contract mechanism and the hybrid blockchain can be used as smart secure contract without compromising any of the facilities. [15]

## 2.5 Proposed Idea

The mutation will be done in the land registration office. The basic view of the architecture is consisting of two visual parts- the miner, and the user-end devices.

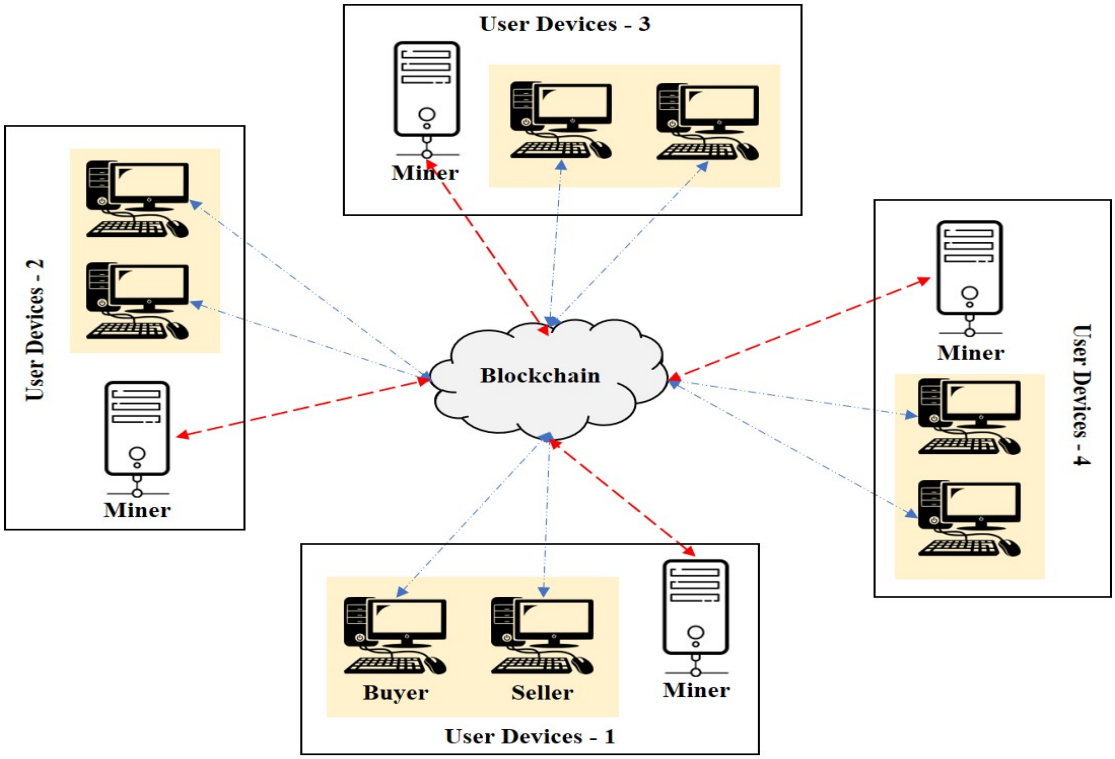


Figure 2.5: Basic Preferences of the system

There will be at least two end devices or here computers **figure 2.5**. As there are two parties, there will be one designated buyer's computer and one will be the seller's computer. If the number of the buyer is plural then they may have to take part by one after another in order to fulfill the mutation. The miner will be the common device and it will be an automatic device that will work by itself and won't take any external command by any third party. There will be at least one miner at each of the land registration offices. The miners will be anonymous as the miner at the designated registration office won't be necessarily responsible for the featured mutation. As all the office's technical architecture will be identical, the buyer and seller won't need to be present in the same registration office. All the miners will be interconnected as the hybrid blockchain system [8], that they will contain same database with own unique identity and the identity won't be accessed by anyone except by the root authority.

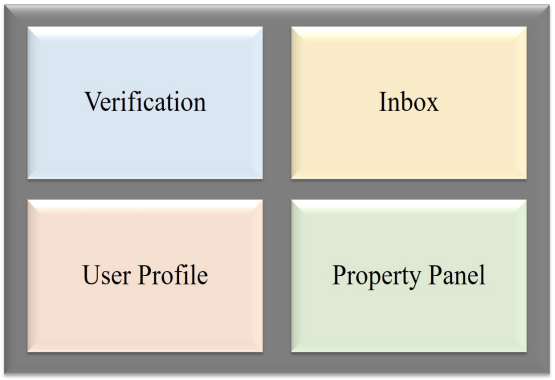


Figure 2.6: Preview of the System

The basic concept is for the ease of access to users. The system will provide an interface consisting of four parts. As in the **figure 2.6** the components are,

- **User profile:** There will be a user profile as the national identification. The government will provide the profile as identical to the government database. These options will be view only as government laws.
- **Property panel:** Property panel will provide an accurate representation of the current and previously owned properties. There will be a history count and according to the count the owner will be able to check the properties owned. The property panel will advance further and apply for mutation.
- **Inbox:** Inbox will provide the government concerned notifications. The inbox will also be used to communicate with possible customers and to get mutation related mails. The government can also provide legal notifications through the inbox.
- **Verification:** It's a major part of the system. There will be at least one verification that has to be by the user. The user can accept a mutation proposal or reject it, that has to be done with the verification system. For the possible seller it also provides an extra stage of security by fulfilling the verification conditions.

# Chapter 3

# Methodology

## 3.1 Overview

In this chapter, we will discuss the theoretical representation of the proposed system. In the first section we will discuss the model of the system and will provide a graphical model. In next two sections we will discuss about land-related logical and legal methods. After that we will classify the systems data sets. In the end we will provide architecture and will describe the architecture.

## 3.2 System Model

Our mutation method consists of a lot of steps that create a complex rate of webs between themselves. There we've tried to draw a simplified flowchart model of our system. The start point is the start and endpoint of the flowchart is 'Start' and 'New Block in Database' which are consecutively represented by the blue and green color. The flowchart is represented in the **figure 3.1**

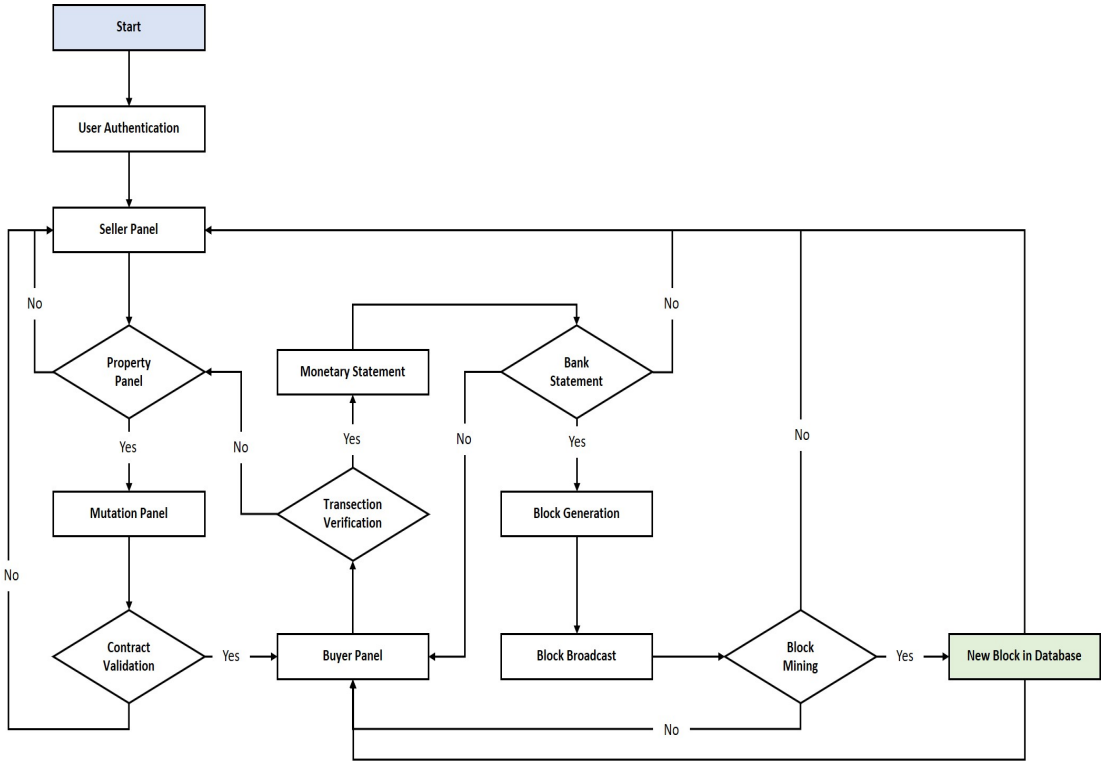


Figure 3.1: Proposed System Model

At the start, a user will face two-factor authentication methods, identification number, and biometric verification which will be provided by the government. Then the user will get a property panel which in the flowchart represented as 'Seller Panel'. In this panel the user who is a possible seller will be able to view and select the targeted land for modification. If the user doesn't own any land or the targeted land, then the panel's value will be null or invalid. Then there's the 'Mutation Panel' where the user has to select and insert the land data, transaction value, and the proposed buyer's identification number. After all the data is registered, the system will then check the database for any erroneous occurrences. The panel will also search for syntactical and syntax errors. If any, then the system will notify the user and deny the verification. If the contract is validated, the contract will be then passed to the 'Buyer Panel'. The possible buyer will also have to pass the same authentication methods to access this panel. In the panel the buyer will verify the contract by him/herself. If the contract matches the buyer's satisfaction, then the buyer will verify the transaction from the 'Transaction Verifica-

tion' panel. The system will then send a request for the transaction to the authorized bank for the exchange value. If the bank verifies, then bank will confirm the system. Else, the bank will notify the system and terminate the progress. Then the system will generate a block with public and private key and hash algorithm. Then the block will be broadcasted to the miners where the random miners will mine to verify the proposed block. This will be done in the 'Block Mining' panel. If somehow the mining fails, then both parties will be notified and process will be terminated. If the mining result comes positive, then the new block will be added to the database. Then the database will be updated and both the seller and buyer will be notified. At the same time the bank will be notified to complete the transaction. After this stage, the previous owner's property panel will have the respective property removed and the property will be added to the new owner's property panel.

## 3.3 Land Identification Method

There are two major landholdings happen in Bangladesh. They are,

- Freehold Land
- Leasehold Land

In the freehold land, the owner of such an estate enjoys free ownership for perpetuity and can use the land for any purposes however in accordance with the local regulations. A leasehold is a form of land tenure or property tenure, there one can buy the right to occupy a building or land in a limited period of time. For the sake of the complexity, here we are just working with the freehold land registration and mutation system. There are 19 different documents that represent the documental ownership of freehold land as a set. But all of the documents may not require all the properties. The type of document required for ownership depends on the area, environment, time and facilities. But certainly, there are some documents that are must for any property in Bangladesh. They are,

- CS, SA, RS, and BS Porcha

- Sale Deed
- Land Mutation (RS)
- DCR Receipt
- Khajna Receipt
- City Corporation Holding Tax
- Non-Encumbrance Certificate
- Old Drawing
- Map

These are the most needed documents required for a landowner. These documents together provide the registration of a land. Without any one of these documents it will be very complex to prove the ownership of a land and as well as to mutate a land.

## 3.4 Data Extraction

All the documents provide a lot of information. That information can be classified into two categories. They are,

- Numeric data
- Logical data

The Numeric data are the actual numbers that represent a piece of property that is represented by all the documents. After analyzing some sets of data we've found out that there are only few data to represent the geographical position of the property. The property information contains three different data,

- Mouza (Area) number
- Dag (Plot) number

- Quantity

These data contain common numeric results and when acting as a set they result a unique figure in a complete area. In a country these set represents a certain property without conflicting with any other sets. The transaction data is the predefined price of the designated property which will be determined by both parties. The quantity of a plot is a common variable, but with a Plot number it becomes a sub-set. The sub-set is only effective in a fixed mouza, as there are multiple mouza and they may have same Plot number with same quantity. But there is only certain mouza in a country and for Bangladesh there are 491 Mouzas. All the Mouza is represented by a unique number, so the repetition of a land document is not possible. The final set may look like this **figure 3.2**,

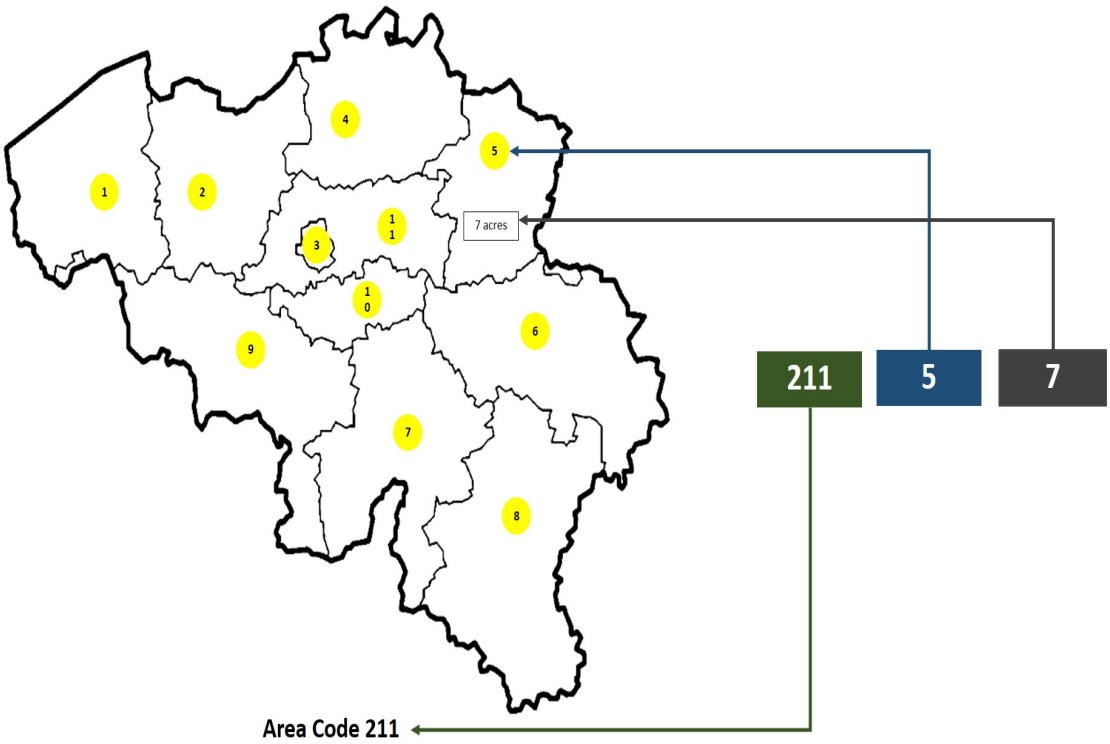


Figure 3.2: Area Identification Method

The 211.5.7 represents a particular land on the map. Here the '211' is the Mouza number, the '5' is the Dag number, and the '7' is the quantity of the land. There can

be many 5.7 in different Mouzas but, together the numeric value 211.5.7 is can not be duplicated in a country.

Logical Data are those validations from the government-appointed authenticators. The CS, SA, RS, and BS Porcha represents most of them. These data provide the validation of the property, which can be encrypted with the digital signature encryption. And then the analog representation of those data won't be necessary as the data will be saved. Then after every mutation, these Porcha will be regenerated for new owner. Sale Deed and RS are directly connected with land mutation. That part will be automatically covered with the mutation system and will be stored forever in the history of the land. The government taxes will be connected through the government-controlled blocks. These clearances will be automatically added to the respective blocks as the owners pay them. Encumbrance Certification will also be connected through the government-controlled blocks with the legal resolutions. Finally, there is a scope to add the graphical map in the system, the map can represent the plot level identifications. Otherwise, the numeric representation is the most accurate measurement of land, which already exists in our system.

## 3.5 Access Distribution

Our hybrid blockchain provides two types of access to the system. They are,

- End-User Access
- Authority Access

The end users are the general users in the system. All the user account will be predefined and provided by the government authority. The information of the users will be the same as the National Identification (NID) database, and users will not be able to modify the data without the permission of the authority. A general user will not be able to register an account by him/herself. Users will get profile data which is view only and there will be a property panel, where a user can change data by requesting the mutation request.

There will be authorized access which will be provided to the government authorities. The authorities include Ministry of Land, Land Record and Survey Department (LRSD), National Housing Authority, Bangladesh Economic Zones Authority (BEZA), Land Reforms Board, and Supreme Court of Bangladesh. The authorities will have classified for certain access. There will be also Bangladesh Election Commission's access for the user data registration and verification. The LRSD will be responsible for the survey of the land. The housing, economic, and land reform are responsible for determining the land's condition and value. They will always set parameters for different state of lands, and the set range for the value of the land. The land ministry will provide all the land data at the beginning and will monitor the mutations. The supreme court will have the power of modification through the land ministry for affidavits. The court will also be responsible for the legal statement of the land and will notify the owner of any consequences

## 3.6 System Architecture

The mutation will be done in the land registration office. The system has three structural parts and when together they pair up, they complete the architecture of the system. These parts are consisting of three different processes. There is a common part of every private user which is their profile. The profile contains some exclusive data such as the identity of the user, the properties owned by the user and the available options for the properties. Then there are common options. The first part of the system involves the available options for the user. Generally, the user has the right to do whatever the user wants to do with the property. Here we've included the mutation method to occupy some of the rights. By the mutation method a user can sell, donate, or gift someone the owned property with the proper statement. But to complete the mutation the user has to process the formalities and that needs to validated by the proposed owner. Here comes the second part of the architecture, the validation part. A user may put anything on the mutation proposal but it needs to be satisfied by the proposed user. So, after passing all the formalities from the proposer, the system will generate the contract and

ask the proposed user's permission to validate it. If the proposed user validates, then the contract will be stablished and the system will then generate a block from the contract. Then the block will be on the blockchain verification system for the authenticity of the system. This is the third part of the architecture. There are total of five different sets of blocks that will be involved in the verification session. After the verification, if the proposed block passes then it will be added to the database and the ownership will be exchanged. At the same time, the previous block will be inactive and there will be another block if the proposer mutated fraction of the property. The second block will be automatically generated from the same authentication process. There is an exchange system. That have to be done by the government authorized digital bank. There have to be pre-defined banking statement and the statements have to be connected to the system. When a user validates a proposal, the system will ask for the exchange statement. The bank will confirm either the proposed user is capable to own the designated property or not. If not then the bank will terminate the process and deny the new block. So, there will be no change and both the parties will be notified. If the bank statement is true then the bank will approve the block to be validated in the miner, and after completing the mining the block will be added to the blockchain database. At the time the update will be received by the bank also, then the transaction will be completed. At the time of mining, the transection amount in the buyer's account will be temporarily seized and at the end of the mining, the state will be updated.

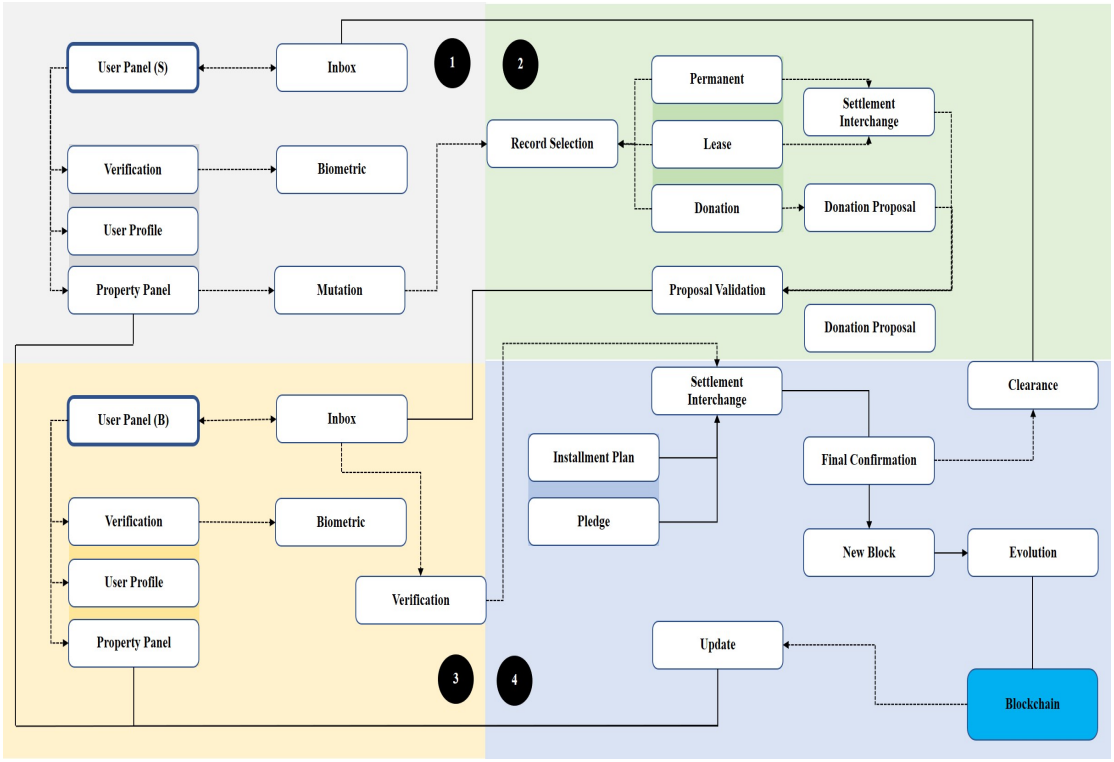


Figure 3.3: Proposed System Architecture

The core of the mutation system has four parts**figure 3.3**. The parts are designated as the 1. Seller interface 2. Mutation progress 3. Buyer interface 4. Transection and mining process All the parts are designed to fulfil the mutation in a very simplified and cleaner manner.

### 3.6.1 User Interface

Both the seller and the buyer interfaces will be identical and for use case they will react differently as designated. The user options will the same as it is the **figure 3.3**The difference occurs when a user decides to sell his/her property and one accepts the property for a certain exchange. The accounts will be provided by the government appointed authorities. The accounts will contain the biometric verifications as the national identification system. At the user panel the user will find biometric login panel. After login, there will be view only panels as the profile, personal information, property panel, and

inbox.

### 3.6.2 Mutation Process

The property panel contains the present and previously owned property and the history related to the property. There will be an advanced panel named mutation. The mutation panel is the desired option for the seller. In this panel the user has to insert the required data for the mutation. The data varies for the type of the mutation which is pointed as the record selection **figure 3.3**. Then according to the selected type, the data have to be inserted. Basically, the data are buyer information, property information, and transection data. For the buyer information we recommend the expected buyer's national identification number. This also will act as the public key [9]. The transaction data is the predefined price of the designated property which will be determined by the both parties. Here the mutation progress part ends. Then these data will be sent to the destined buyer as the seller applied. The seller will then receive the validation request message from the system. The proposed buyer then has the brief details of the proposal. If the proposal satisfies the user, then he/she may validate the offer with the acceptance option. The buyer task ends here. Then there comes the most complicated part, the transection and the mining process.

### 3.6.3 Mining and Transaction

This part consists of two separate system- banking transection and the blockchain mining. There is a predefined task for the buyer and it have to be done at the government authorized bank. The buyer has to have the required transection amount at the respective bank account and the transection amount have to be stated in a digital statement in the account. At the mutation process, when the buyer validates the propose, the system will contact the bank to check the required transection statement. If the check result turns negative, the process will be terminated. For the positive result, the system will then generate blocks (single block for whole property mutation, two blocks for fractional property mutation) and release them to the blockchain database to evolve and to

be verified by the set of blocks. If the verification process denies the mutation, the proposed blocks will be deleted and the progress will reset. After the verification, the new blocks will be added to the database, and also be added to the user panel of both users. For the buyer there will be a new block linked to the parent block. For seller there will be a new block if the mutation is for a fraction of the property, and the previous block will be muted and linked to the new block. For the full property mutation, there will be no new block, the previous block will be mutated and connected to the new block of the new owner of the property. All the blocks contain the parent hash data and the same structure as, head + data + foot [10].

## 3.7 Discussion

There are more than 45 different types of documents required for different types of mutations in Bangladesh. There are also several types of mutation policies records exists too. The whole system is way more complicated than the designed architecture. We've just demonstrated the basics of the architecture with the simplest type of mutation. Other types of mutations can also be done in the same format with some more algorithms. The system requires banking statement, the statement have to be done by directly connection with the blockchain database. This concerns a mild security issue as the hybrid blockchain connects third-parties with the end users. Also, the bank statement system is still a hypothetical system, but theoretically it works fine. We've face difficulties while dealing with the legal issues for lands, as there are several lands which aren't yet updated their documents, many of them are hanging on the courts for decades, and many are mis-spelled in the documents. These issues will take time to solve. The land laws are not flexible enough to get a straightforward method of digital mutation. The machines used in the system are expensive and requires expensive maintenance. The plus point of using the distributed miners is that, in case some fails, there will be plenty more to keep the mining process running. Here is also a threat too, there are certain number of miners in certain locations, it is also expose of physical malfunction, and security breakout. There need to be a set instruction to perform a backup mechanism

and prevent the malicious behavior of a miner. There also needs a required number of active miners to initiate mining. Damage of working miner can cause a valid mutation to fail, it needs to have a backup. The miner database has a limited storage access, there we need to optimize data. After ages, the miner won't have the capability to store all the mutation data and it will be time consuming if the database gets bigger. Then it has to be optimized somehow. We propose there should a range for data history in the blockchain. The previous should be in a separated storage with a on prompt connection with the blockchain.

# Chapter 4

# Implementation and result

## 4.1 Overview

We've tried to implement the proposed system in a sequential manner. As the proposed system is way too complex and big for a small number of developers, we've tried to go through step by step. This chapter discusses the final result of our study period in a practical manner.

### 4.1.1 Block Creation

For our proposed system, user data will be saved in a block per set. Then the block will be used for further use. In our implementation, we've successfully created blocks per data set and checked it's vulnerability. The block will be created as followed, at first there will be a block id where the previous block id will be integrated. The new block will be generated with a public key and hash address. With the hash the block will also be added the private key and a signature key. The system of creation of new block is represented in the **figure 4.1**. The previous blocks will be inactive, but not deleted. They will remain in the database for good but won't be active and act as the history [16].

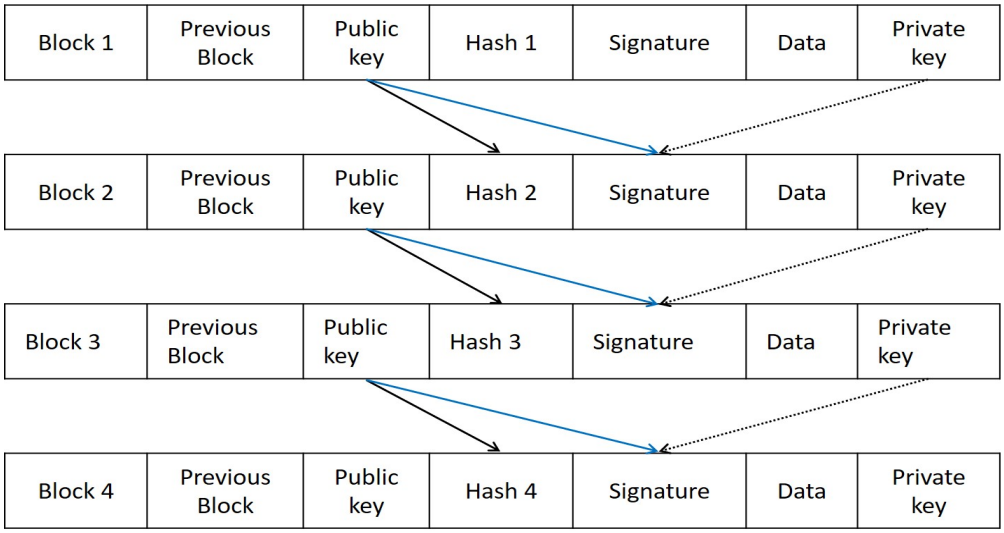


Figure 4.1: Block creation method

### 4.1.2 Development Method

For Development, we've chosen the waterfall model. That gave us the benefit of rigidity to the system and we were able to breakdown the project activities into linear sequential sets, where we were able to work the whole system department wise at the same time. The development steps of our proposal model were, Requirements: At first, we had to choose the basics of the system. We've decided to start the system from scratch and try to develop as much as possible. So, our first requirement was to be able to create a block and to validate it. Design: Then we've designed the system architecture which was discussed in the methodology chapter. The architecture was the full version of the system, but here we were able to complete a part of that system. Implementation: At the implementation process, we've tried to put our study and knowledge together to develop the part of the system. Here we were able to create a block. Verification: We had prepared some test cases; we have run the test cases to see the results. The outcome was comfortable as the program run as expected and the motto was succeeded.

### 4.1.3 Programming Language Platform

For the programming, we've chosen 'Python' as the programming language. There were multiple reasons to choose this language. Python allowed us to express concepts without writing additional code. Unlike other programming languages, emphasizes code readability, and allowed us to use English keywords instead of punctuations. It also supports several programming paradigms. It supports object-oriented and structured programming fully. Its interpreters to run the code on specific platforms and tools. The large and robust standard library makes Python score over other programming languages. Its open-source programming language, Python helps us to curtail software development cost completely. At the same time, the data visualization libraries and APIs provided by Python help us to visualize and present data in a more appealing and effective way. For the environment, we've used Visual Studio as the Integrated Development Environment (IDE). Visual Studio Code combines the simplicity of a source code editor with powerful developer tooling, like IntelliSense code completion and debugging. The delightfully frictionless edit-build-debug cycle means less time fiddling with the environment, and more time executing on ideas. That's why we've used Visual Studio as IDE.

### 4.1.4 Data Collection and Implementation

The land data is mostly restricted and, the names are often disclosed to public view. But the data as the Mouza number, Dag number, quantity, and possible value is accessible. For that, we've collected some real-time data from the Land Record and Survey Department's website where we've added the imagined names and values. The data set is **figure 4.2**,

| Serial | Seller name | Mouza name | Mouza no. | Dag no. | Acre | Amount( BDT) | Buyer Name |
|---|---|---|---|---|---|---|---|
| 1 | Samad | sirajganj | 175 | 1253 | 54 | 400000 | Jahangir |
| 2 | Saamd | sirajganj | 175 | 517 | 25 | 500000 | Dobir |
| 3 | Samad | Sirajganj | 175 | 1434 | 28 | 600000 | Lutfor |
| 4 | Samad | Ulla-Para | 156 | 1002 | 12 | 700000 | Jahangir |
| 5 | Jahangir | Foriyadpur | 122 | 507 | 24 | 10,00000 | Kabir |
| 6 | Jahangir | Foriyadpur | 122 | 1000 | 03 | 20000 | Shimul |
| 7 | Nayan | Gopalpur | 73 | 123 | 38 | 1300000 | Hera |
| 8 | Nayan | Gopalpur | 73 | 1005 | 66 | 1400000 | Hera |
| 9 | Hanif | Shadupara | 70 | 34 | 10 | 100000 | Jannat |
| 10 | Hanif | Shadupara | 70 | 34 | 20 | 200000 | Osman |
| 11 | Polas | Atuya | 71 | 45 | 33 | 455555 | Sahin |
| 12 | Polas | Atuya | 71 | 78 | 99 | 2000000 | limon |
| 13 | Dobir | Ullapara | 175 | 507 | 24 | 700000 | Raihan |
| 14 | Dobir | Ullapara | 175 | 445 | 27 | 800000 | Obaidulla |
| 15 | Dobir | Ullapara | 175 | 1002 | 12 | 700000 | Aansar |

Figure 4.2: Data sets for Land Registration

We have designed the interfaces for the system by which we've implemented some random data from the table. The first represented data is the 4th from the table. The input of the system was graphically represented in **figure 4.3**.

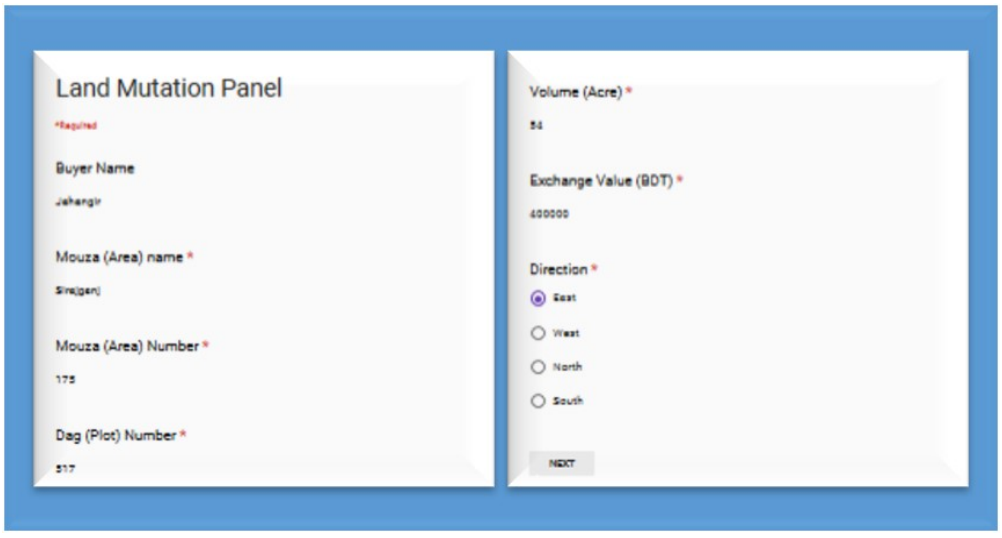


Figure 4.3: Block data in GUI

The Command Line interface of the system looks as in figure 4.4.


Figure 4.4: Block data in CLI

Here in CLI, the recipient is the proposed buyer of the property, the volume is the quantity of the property, and stain is the plot number.

### 4.1.5 Performance Validation

AThe performance of the system is the immobility of the stored data. After inserting the block data, we have to choose the option of mining to start mine. After mining, there will be a block created as in **figure 4.5**. Then the block data can not be tempered in any way.

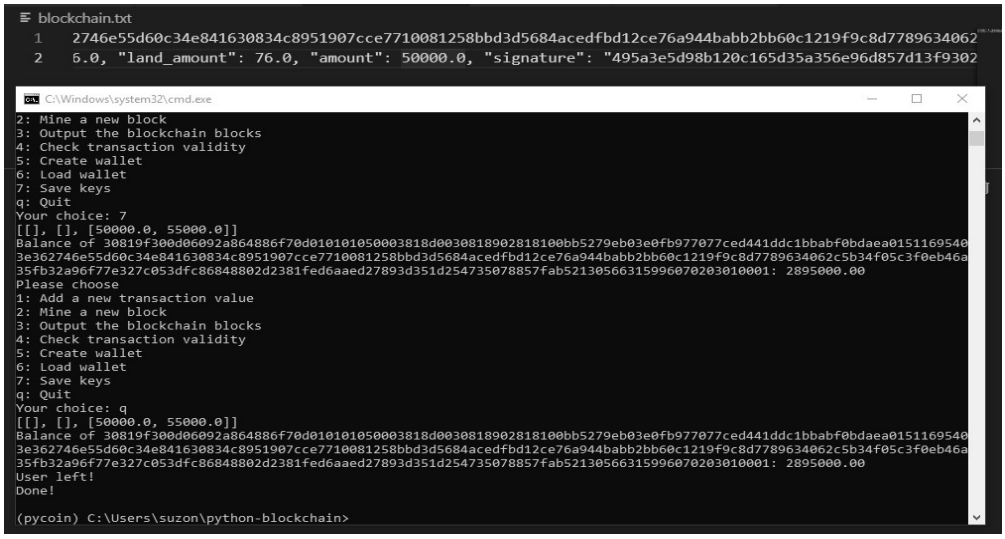


Figure 4.5: Data saving block

In some cases, we've tried to edit the data in database, and the output responses the error with the invalid key message which is shown in **figure 4.6**. It proves that the blockchain provides the compromise less data security at any cost.


Figure 4.6: Data tempering alart

## 4.2 Discussion

Our implementation is based on a block creation and the validation of the block. The block contains the user data as provided. We've tried to prove that the data inside of the block is immune to any threat.

# Chapter 5

# Conclusion

## 5.1 Overview

In this chapter, we discuss the advantages of the proposed system at the beginning. Then we will discuss the work we've done with the remarkable flaws of our system. We'll also discuss the untouched and missed functions of our development. At the end we will discuss our plans for further study about the system.

## 5.2 Advantages

There are several benefits that we will get if we replace our existing land-owning system with the blockchain integrated system. Some of them are,

**High Security:** Blockchain provides the most reliable data protection of all time. This means, no matter what happens our land won't be displaced for any occurrences.

**No Third-party:** Blockchain will also act as the middle-man, but it won't take any benefit from any of the parties. The system is designed to be fair and unbiased, which means there will be no impact from the blockchain as a third-party.

**Transparency:** Blockchain will provide a thorough view of the documentation. The possible buyer and seller will be able to know about the latest condition of the discussed property, and transaction. So, there will not be any fraud happening.

**Safest Transaction:** The system will provide the safest transaction system as happens in the smart contract system. There will be seized statement for the time the system will mine. At the end of the mining, either the transaction will happen for positive results, or the seize of statement will be taken for negative results. So, there will be land and value interchange at the same time or, no interchange at all.

## 5.3 Limitation of Research

The land is not a simple process and it needs time to resolve. The system requires thorough investigations for the betterment.

Our work was to design and develop the mutation system. Since the start of our thesis, we've reached this point where we are able to create and validate the authenticity of the block theory. Our research was not completed due to the time limitation. The whole system requires higher level of study and programming skills. It also requires more resources as the system is to serve a big number of people. The land system is way more expended than the proposed system. Here we've discussed only the freehold land. But there are leasehold lands, and other custom subleased lands, that requires more development in design. There are also legacy land registrations, donations, mortgage system, etc. and many more systems which were not studied. The complete system will require expert level executives to design and develop.

## 5.4 Future Works

For the future, we've planned some further researches. They are in a sequence below,

- Develop the mutation process
- Develop the multi-user accessibility
- Rebuild the block system UI for a tabular representation
- Develop the system UI thoroughly

# References


[1] G. Zyskind, O. Nathan *et al.*, "Decentralizing privacy: Using blockchain to protect personal data," in *2015 IEEE Security and Privacy Workshops*. IEEE, 2015, pp. 180–184.

[2] R. C. K. Roy, *Land rights of the indigenous peoples of the Chittagong Hill Tracts, Bangladesh*. Iwgia, 2000, no. 99.

[3] M. Haque, "Bangladesh land conflict monitoring report," *IN DEFENSE OF LAND RIGHTS*, p. 46, 2019.

[4] S. Feldman and C. Geisler, "Land expropriation and displacement in bangladesh," *The Journal of Peasant Studies*, vol. 39, no. 3-4, pp. 971–993, 2012.

[5] M. Attaran and A. Gunasekaran, "Blockchain principles, qualities, and business applications," in *Applications of Blockchain Technology in Business*. Springer, 2019, pp. 13–20.

[6] G. Ateniese, M. T. Chiaramonte, D. Treat, B. Magri, and D. Venturi, "Hybrid blockchain," May 23 2019, uS Patent App. 16/259,310.

[7] I. Eyal, "Blockchain technology: Transforming libertarian cryptocurrency dreams to finance and banking realities," *Computer*, vol. 50, no. 9, pp. 38–49, 2017.

[8] M. Mettler, "Blockchain technology in healthcare: The revolution starts here," in *2016 IEEE 18th International Conference on e-Health Networking, Applications and Services (Healthcom)*. IEEE, 2016, pp. 1–3.

[9] H. Hou, "The application of blockchain technology in e-government in china," in *2017 26th International Conference on Computer Communication and Networks (ICCCN)*. IEEE, 2017, pp. 1–4.

[10] M. Turkanović, M. Hölbl, K. Košič, M. Heričko, and A. Kamišalić, "Eductx: A blockchain-based higher education credit platform," *IEEE access*, vol. 6, pp. 5112–5127, 2018.

[11] N. Kshetri and J. Voas, "Blockchain-enabled e-voting," *IEEE Software*, vol. 35, no. 4, pp. 95–99, 2018.

[12] A. Dorri, S. S. Kanhere, R. Jurdak, and P. Gauravaram, "Blockchain for iot security and privacy: The case study of a smart home," in *2017 IEEE international conference on pervasive computing and communications workshops (PerCom workshops)*. IEEE, 2017, pp. 618–623.

[13] S. Huh, S. Cho, and S. Kim, "Managing iot devices using blockchain platform," in *2017 19th international conference on advanced communication technology (ICACT)*. IEEE, 2017, pp. 464–467.

[14] Z. Zheng, S. Xie, H. Dai, X. Chen, and H. Wang, "An overview of blockchain technology: Architecture, consensus, and future trends," in *2017 IEEE International Congress on Big Data (BigData Congress)*. IEEE, 2017, pp. 557–564.

[15] Y. Zhang, C. Xu, J. Ni, H. Li, and X. S. Shen, "Blockchain-assisted public-key encryption with keyword search against keyword guessing attacks for cloud storage," *IEEE Transactions on Cloud Computing*, 2019.

[16] I.-C. Lin and T.-C. Liao, "A survey of blockchain security issues and challenges." *IJ Network Security*, vol. 19, no. 5, pp. 653–659, 2017.

# List of Acronyms

| | |
|---|---|
| BC | Blockchain |
| DB | Database |
| IoT | Internet of Things |
| LRSD | Land Record and Survey Department |
| BEZA | Bangladesh Economic Zones Authority |
| IDE | Integrated Development Environment |
| GUI | Graphical User Interface |
| CLI | Command Line Interface |