

# A Blockchain Based Secured Land Record System Using Hyperledger Fabric

Md. Anwar Hussen Wadud<sup>1,2</sup>, Tahmid Ahmed<sup>2</sup>, Alhaj Hossen<sup>2</sup>, Md. Mahedi Hasan<sup>2</sup>, Md. Aminul Islam<sup>2</sup>, and Md. Hasibur Rahman<sup>2</sup>

<sup>1</sup> Dept. of CSE, Mawlana Bhashani Science and Technology University, Tangail

<sup>2</sup> Dept. of CSE, Bangladesh University of Business and Technology, Dhaka

**Abstract.** In Bangladesh, scarcity of land and fast population growth is putting a strain on the land-man ratio. The property ownership registration system in Bangladesh is incomplete and insufficient. As a result, various government agencies handle various documents, and bureaucracy flaws enable organized crime. Considering these, we are proposing a method where we have come up with a Blockchain-based solution. We build a Blockchain-based system to ensure that individuals are not deceived under any circumstances. In our system, where land data will be safe and secure, data synchronization and transparency will be available, as well as ease of access, irreversible record management, and rapid and low-cost quick solutions. We designed a modern architecture to digitally store land records using Blockchain-based Hyperledger Fabric to ensure land security. This proposed model has been presented by private Blockchain, taking into account the technological expertise and authority of the people and government. Finally, we compare our proposed architecture with the existing land records management model. Our system provides more security and data privacy than other models and saves both money and time in our daily lives. This will ensure that our system is transparent and acceptable in all directions.

**Keywords:** Land Registration · Blockchain · Hyperledger Fabric · Privacy · Security.

## 1 Introduction

Land registration is a system that keeps track of who owns something and what rights they have over it. Blockchain is a remarkable new technology that can provide any agency's systems trust, integrity, and accessibility. A database, or Blockchain, is a sort of digital ledger. In most cases, Blockchain accumulates data in groups, sometimes known as blocks, that contain sets of data. Blocks have specific storage capabilities, and when filled, they are chained onto the previous block, establishing a data chain known as the "Blockchain." All additional information added after that newly added block is compiled into a new block, which is then added to the chain after it is filled[1].

Hyperledger Fabric is a private Blockchain. Businesses can use distributed ledger technology without exposing their data to the public by using a private Blockchain. This website is password-protected. The Blockchain allows only known nodes to participate in the procedure[2].

The primary problem in the current system is that data is dispersed across multiple government institutions that aren't well-synchronized, enabling hacked persons to modify legal papers. A centralized system will be insufficient to cope with the various land titling frauds in this case[3]. In this research, we evaluate Bangladesh's present land registration process and propose a new framework based on Blockchain technology to improve transparency and dependability[4].

In the past, there was a manual system for land registration. At that time we faced many problems. This existing system takes a long time. On the basis of Bangladesh, there are some illegal means of registration. However, before this study, no work has been introduced on the digitization of land registration using Hyperledger Fabric framework. In this paper we are going to introduce the digital version of the land registration system where we use a Hyperledger Framework with Blockchain technology[5].

The present age is the digital and modern age and technological development is increasing day by day. Everything we need in our daily lives is going digital. As we have analyzed, people have already been recording land with pen in hand which is not going to keep pace with the digital age, and this manual system leaves people facing a lot of harassment. However, to analyze human demand, we want to develop a land record system that is easily accessible to the user. This system is very easy to use for users and it's very secure for user information. The study work's overall performance is as follows:

- We highlight a current challenge in analyzing human demand in the Secured Land Service.
- We propose a secured land registration model using Hyperledger Fabric based Blockchain network.
- We reduce manual involvement by implementing actual property title assignments and ensuring the security of public land data.

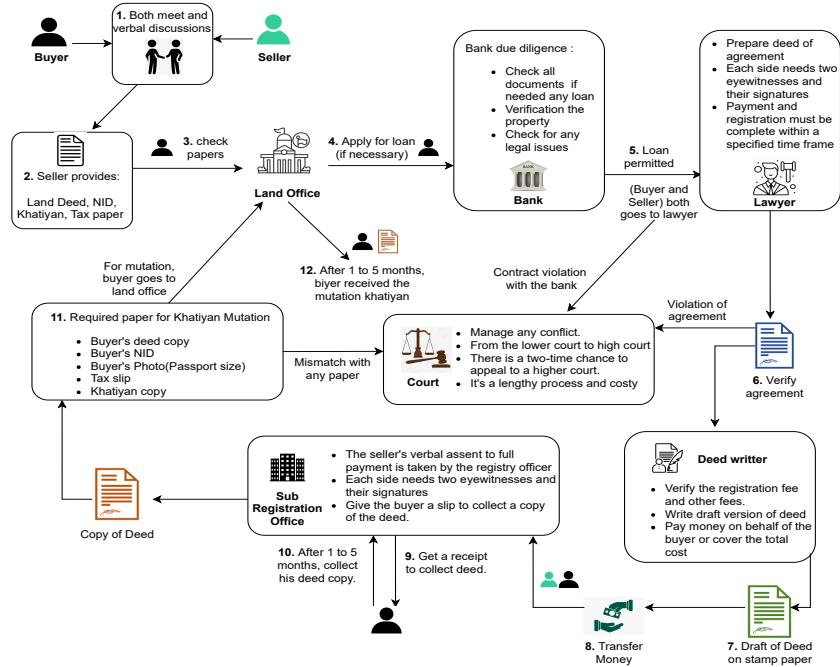
The following is how the rest of this article is organized: section 2 discusses the land verification process In Bangladesh and section 3 discusses the related works of the land record management system. Section 4 briefly explains Blockchain technology, smart contract, and Hyperledger Fabric. Also, section 4 discusses system architecture and implementation of our recommended framework. Finally, this study concludes with future guidance in section 5.

## 2 Land Verification Process In Bangladesh

### 2.1 Existing Methods for registering property in Bangladesh

In Bangladesh, anybody has the legal right to process an immovable property of land. The general public in Bangladesh is ignorant of the complex Record of Rights (ROR) transfer processes, which require hundreds of papers handled

by several government departments and take a long time to complete. As a result, intermediaries use every administrative and legal gap they can find and use bribes to alter papers in order to harass ordinary people. This, in turn, generates years of legal wrangling and is the primary source of civil disputes in Bangladesh[3]. In Fig.1, we discussed the current working procedure of the land record management system in Bangladesh.

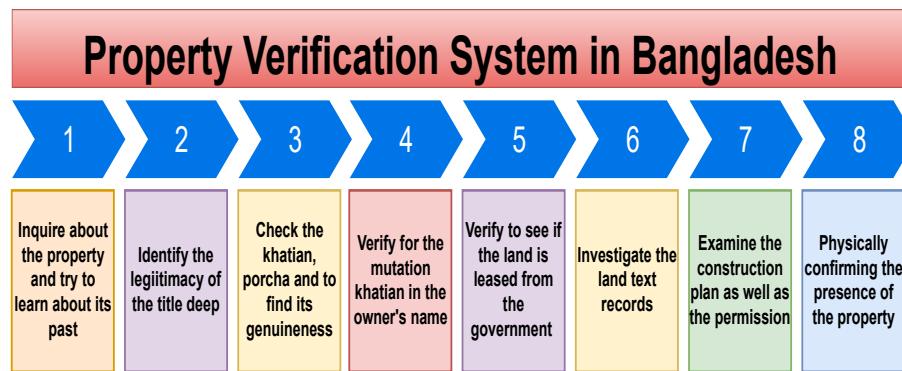


**Fig. 1.** Existing Methods for registering property in Bangladesh

First of all, meet both the buyer and the seller for oral discussions. Then the land documents are examined and verified. The buyer and seller "Agreement to Sell" and get it notarized. If the needed buyer wants to loan for land. Buyer and seller go to a lawyer then verify their agreement. By the lawyer, the document with land money has to be recorded within the stamp paper. Buyer transfer money through the sub-registration office to the seller. Buyer transfer money through the sub-registration office to the seller. The sub-registration office provides a money receipt to the buyer. After one to five months, he collected copies of the documents from the sub-registration office. After obtaining all information, the sub-register office sends it to the land office for mutation purposes. And after one to five months buyer receive the mutation khatiyan through the land office. This is how the existing system works.

## 2.2 How to verify if a property is presently owned in Bangladesh?

Property ownership disputes are quite prevalent in Bangladesh. Property documents are readily faked and untrustworthy. If a person is not careful while purchasing a property, he or she may encounter issues, including a possible dispute with the property's ownership at a later date. Verifying land ownership in Bangladesh, on the other hand, is a time-consuming task. A buyer can check the ownership of a property by following the procedures outlined in Fig. 2.



**Fig. 2.** Property verification system in Bangladesh

## 2.3 Complications with the Present Land Registration System

There are several problems in our current system.

- **Verification of Ownership:** Land registration agencies across the world confront a number of problems, one of which is ensuring owner validation.
- **Historical record of Ownership:** These assets do not have a recorded owning history in many cases. When negotiating with unknown persons, getting access to an asset's entire Historical record of Owning (for example, a piece of land) enhances confidence.
- **Illegally Obtained Land Sales:** Property may be sold without the owners' or insurers' permission, resulting in economic loss.
- **Getting Late For Ownership Of Land Registration:** Land registration and Postpones in the Transfer of Owning on paper are time-consuming, lasting over the month. Erroneous property value might result in erroneous tax or insurance premiums.
- **Fails To Recognize a Fraud:** Present paper-based or technological records are ineffective in preventing identification fraud and identity theft, which can lead to unlawful transactions.

**Table 1.** Compression of Different Proposed Model

Keyword	Mukne et al.[1]	Alam et al.[3]	Thakur et al.[6]	Our Proposed Model
Propose year	(2019)	(2020)	(2019)	(2021)
Country	India	Bangladesh	India	Bangladesh
Challenge	Anti-corruption	Digitized	Ownership Transparent	Archive digitization
Proposed model	One phase	Three phase	One phase	Incremental two phase
Blockchain Architecture	Permissioned	Public and hybrid	Privet or Public	Permission
IPES	Enabled	Enabled	N/A	Enabled
Experimental Result	Moves phase One to two	Prototype	N/A	Compared with benchmark

### 3 Related Works

Md Sakibul Islam et al.[4] proposed digital land registration model, where they used Ethereum, a public and permissioned Blockchain to build their model. In their article, the privacy question is answered to a large extent by integrating the land registry on Blockchain. This will be the most suited and also give infinite processing capabilities, but there's been no earlier work on private Blockchains such as Hyperledger Fabric. Due to the complexity of the technology, its maturity level, and unusual first implementation that does not emphasize the true benefit of Blockchain, consumers have diverse opinions and attitudes about the technology [7]. They explained the earliest Blockchain technologies were public implementations for cryptocurrencies. Kazi et al.[3] suggested a Hybrid Blockchain-based system that assures stakeholder coordination, data transparency, ease of access, and controls immutable transaction records in this research. Given the government's and general public's technological immaturity, they suggested a three-stage Blockchain adoption strategy that begins with public Blockchain and progresses to a large-scale full hybrid Blockchain. To establish an unchangeable and genuine database for land purchasers and owners, certificates were specially formatted and encrypted on the public Bitcoin Blockchain [8]. The system proposed in [9] this paper follows a decentralized approach of private Blockchain with various consensus algorithms for validating each transaction of land between the new owner and old owner without the involvement of third parties. For a safe and trustworthy land register system, a Blockchain-based architecture is being developed by using ethereum [10]. Table 1 shows the recent works of the different proposed models with our proposed model. Mukne et al.[1] propose a single-level anti-corruption model where anyone can access the system with admin permission. This model enables internet protocol Edge Services (IPES). Consider column two Alam et al.[3], proposes a Three-phase Digitized model where anyone can access it easily. This model enables internet protocol Edge Services (IPES). Consider column three Thakur et al.[6], proposes a single phase Ownership Transparent model where anyone can't access the system because of the private data. This model disables the internet protocol Edge Services (IPES). Consider our proposed model as an Archive digitization model where anyone can access the system with admin permission. This model enables internet protocol Edge Services (IPES).

## 4 SYSTEM ARCHITECTURE

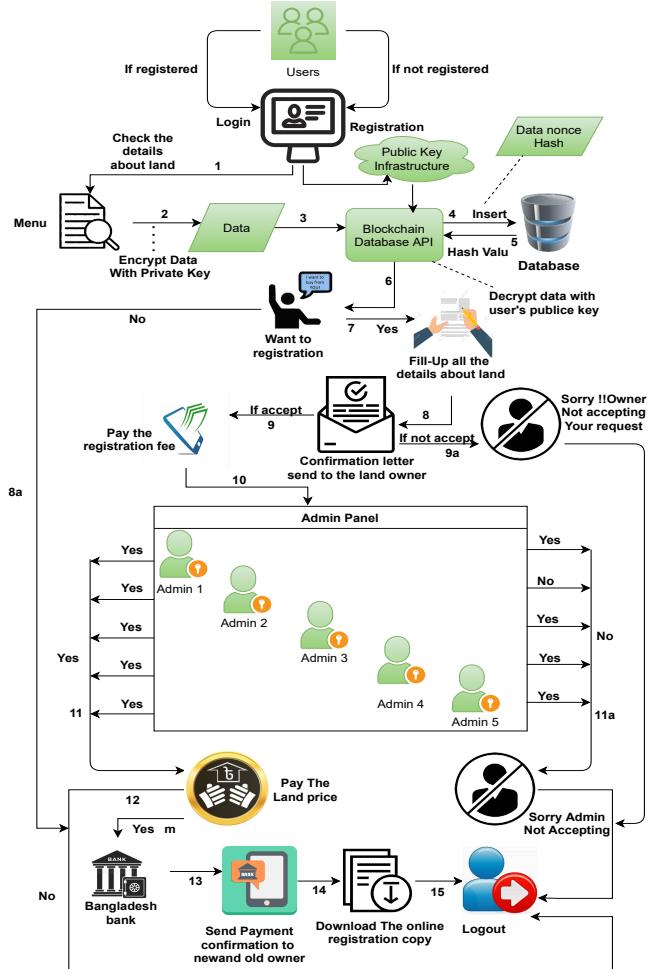
### 4.1 Proposed Model Workflow

Distributed network implementation in real life is the main challenge for us. Because land registration system we can use two types of data. One of them is public and the other one is private data [11]. Public data is available for every user but private data can see only specific users. Such as Ac land, Surveyor, etc. So, Our main goal is to define who sees the public data and who sees the private data. Fig. 3 shows the system architecture of the proposed model. When a user comes to take our service, we will first ask him/her to register. If he/she has registered earlier, he/she will need to log in and enter our system. After the login, an option will come in front of him/her by going to the option called Check Details and he/she will have to be given details input of the land which he/she is willing to purchase. As soon as he/she inputs, our system will show him/her all the details of the land where the area, quantity, landowner, and everything will be there. This will prevent the sale of fake land. If all the information is correct, an option will be shown that says "Wants to registration". Clicking on this option will require filling up a form that will provide all rules and conditions and land information, land price, etc. After submitting this form a confirmation letter will go to the landowner. If the owner accepts the form then show the button which is "pay the registration fee" otherwise there show a message which is the owner not accepting your request. When paying the registration fee then it transfers to the admin panel where all admin checks the papers. If all papers are well decorated as per the rules and regulations then it's asking for the payment for land price. The transaction will be credited to Bangladesh Bank. This money will be handed over to the land owner after a certain period of time. Through this, we will also be able to ensure the security of payments. After transaction, a confirmation message would send both the new owner and the old owner. Finally, the new owner will be allowed to download an online copy of the registration along with the government seal. This is how the system works.

### 4.2 Working Strategy of Blockchain Technology

Blockchain is a decentralized digitized ledger of transactions that is copied and distributed throughout Blockchain's whole computer network structures. Every block of the chain comprises a number of transactions, and when a new transaction takes place on the Blockchain, a record of that transaction is recorded to each user's ledger[10]. Blockchain is a distributed ledger system in which data is stored using a hash, which is a cryptographic signature that cannot be changed [12]. If hackers wanted to harm a Blockchain system, they'd have to change each block in the chain across all distributed versions.

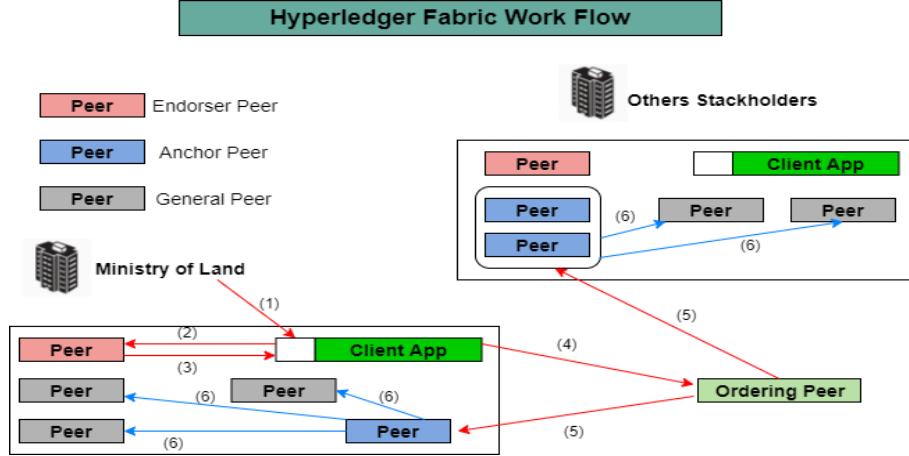
**1) Smart Contract:** A smart contract is a type of code (written in Go, node.js, or Java) that enforces contract processing between parties using Hyperledger Fabric. Smart contracts use data from the Blockchain to automate corporate processes and workflows[13]. An idea of smart contract automation is monitoring



**Fig. 3.** Proposed System Framework for Land Registration System

an SLA and subsequently committing a reduction to the ledger for the given IT solution if it is violated.

**2) Hyperledger Fabric:** Hyperledger Fabric is a private Blockchain. A private Blockchain enables businesses to use distributed ledger technology without providing their data to the public. This is a permissioned Blockchain, which means that only recognized nodes can join the network[2].The Fabric has several components. The major components of fabric are listed below.

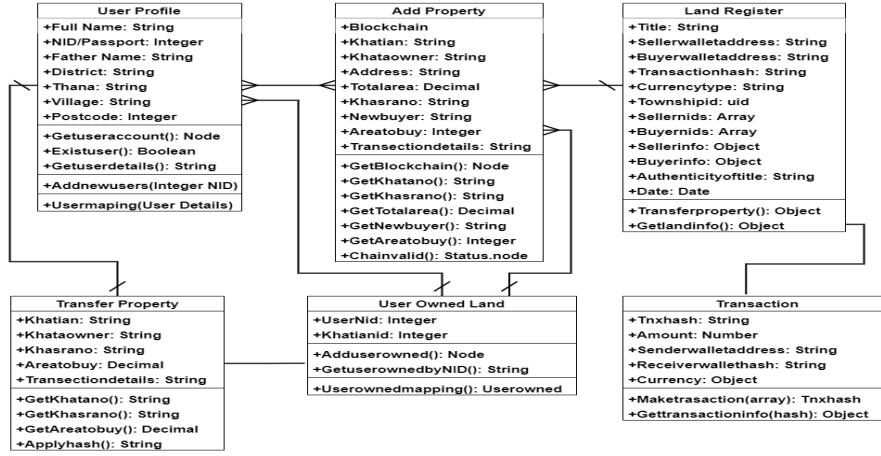


**Fig. 4.** A Hyperledger Fabric Workflow

1. **Membership Service Provider(MSP):** Membership Service Provider (MSP) is a component that attempts to encapsulate the membership operation architecture.
2. **Client:** Clients are apps that suggest transactions over the network on behalf of a user. To connect with a network, the client employs a Fabric SDK.
3. **Peer:** The state and the ledger transact a node to maintain a copy. The ordering service sends blocks to a peer, who maintains the state and ledger.
4. **Ordering Service:** The ordered service offers orderers a connection that ensures delivery for the Hyperledger Fabric.

**3) Hyperledger Fabric Work Flow:** Hyperledger Fabric is a permissioned Blockchain network created by organizations that want to form a consortium. Each Blockchain network member organization is responsible for ensuring that its peers are ready to join the network. Fig. 4 shows the step by step workflow of the Hyperledger Fabric network.

- A transaction request is initiated by a participant in the member Organization using the client application.
- The transaction invocation request is broadcast by the client application to the Endorser peer.
- To confirm the transaction, the Endorser peer examines the Certificate information and the others. The Chaincode (i.e. Smart Contract) is then executed, and the Endorsement replies are returned to the Client. As part of the endorsement response, the endorser peer provides transaction approval or rejection.
- The client now transmits the authorized transaction to the Orderer peer, who will organize it correctly and put it in a block.



**Fig. 5.** Class Diagram of Development Land Registration System

- The transaction is placed in a block by the Orderer node, then sends the block to the Anchor nodes of the Hyperledger Fabric network's various member Organizations.
- Anchor nodes then disseminate the block to the rest of their organization's peers. The newest block is then updated in each peer's local ledger.

## 5 THE IMPLEMENTATION OF BLOCKCHAIN IN LAND RECORD REGISTRATION

Represents the class diagram of the private blockchain platform's smart contract development objects (user profile, add a property, transfer property, user Owned land, transaction) as shown in Fig. 5. Personal information, addresses are stored in the user's NID. With this NID user information, there is an interface for retrieving currently owned land and whether the user exists. A unique ID will be provided to someone while adding the land details to the database. ID ensures ownership of land. The landowner can promote his own land with the unique ID mentioned. when anyone can buy and sell any land or property then can use transfer property and transection section otherways he will not use this system. user owner land section confirms the existence of the landowner and provides information. Similarly, there are necessary identifier information, multiple ownership support, ownership transfer process. On the other hand, a land registration ensures the location of the object and the identifier information. Each object is bound to the user of the blockchain.

**Table 2.** System Environment

Hardware	Configuration
Operating System	Ubuntu Linux 18.04.1 LTS
CPU	Single vCPU @ 2.00GHz
Memory	32GB
Hyperledger Fabric	Version 1.2
Docker-Compose	Version 1.5.2
Oracle VirtualBox	Version 6.1.22
Docker	Version 1.2.1

## 6 EXPERIMENTAL ANALYSIS

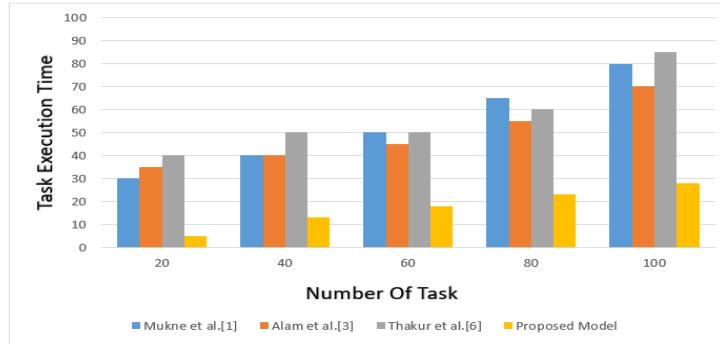
In this part, we discuss the proposed system's implementation. There are two types of Blockchain technology, as previously stated: public Blockchain and private Blockchain. We have chosen the private Blockchain for implementation of the proposed system because our proposed system only requires a few nodes and so it is a cost-effective approach. In this paper, a variety of Blockchain implementations have been deployed for constructing Blockchain-based applications. We utilized the Hyperledger Fabric Framework (Linux Foundation, Hyperledger Fabric 3) for Ubuntu (Linux version) to develop the suggested system since it is a private Blockchain implementation with good reliability and a stable community. We also utilized a Hyperledger Composer that appears to support the Hyperledger Fabric framework and runtime (Linux Foundation, Hyperledger Composer 4). It's a suite of tools for creating Blockchain-based solutions quickly. Other tools used to implement the proposed system involve:(a) Client URL (a library for sending data using different protocols), (b) Docker and docker-compose (used to construct and operate numerous Blockchain network containers), (c) PHP,(Hypertext Preprocessor ), and (d) NodeJs (used to create smart contracts).

We perform the offered model utilizing Hyperledger Composer and Fabric. Through our analyses, we assume that the user data is recovered of the JSON, and demanded data by using the Rest User, for instance, Postman server. Each server was created on the Virtual EC2 instance On AWS, which serves as Ubuntu Linux 18.04.1, 32 GB RAM and single VCPU @ 2.00 GHz on the similarly local PC. As the description of the summary in Table 2. To develop the entire architecture, we applied the Hyperledger composer playground. We utilized Hyperledger Fabric (v 1.2) Linux foundation with hosted an open-source project.

We have used Blockchain technology to ensure user validation used in our project where each customer ensures validation by matching the land ledger number is shown Table 3. Identity Management, Data Monitoring and Availability, as well as Decentralized Access, Flexibility and speedy and low-cost quick solutions, will all be accessible in our system, which will keep land data safe and secure. Our proposed system has a decentralized network with an immutable transaction history for a forge-proof system that can also keep track of all papers online. Lastly, our best reason for all models is the time factor. Other models

**Table 3.** Comparison of Existing Works with Proposed Work

Key Terms	Mukne et al.[1]	Alam et al.[3]	Thakur et al.[6]	Proposed Model
User Validation	✓	✓	✓	✓
Identity Management	✓	X	✓	✓
Data Monitoring	✓	✓	✓	✓
Decentralized Access	✓	✓	✓	✓
Availability	✓	X	X	✓
Flexibility	X	X	X	✓

**Fig. 6.** Tasks Number vs Execution Time

need maximum time whereas our model takes less time for each task. Additional transactions can be done through our model in the short term. As we see, the graph of Fig.6 shows that each set needs less time to complete the task. But as the number of tasks increases, the number of executions will also increase. Although our model always needs less time than others. When the number of tasks is 0-20 then our model completes the transaction in 5 seconds. Whereas other models require 30-45 seconds. Similarly, when the number of tasks is 20-40, 40-60, 60-80, and 80-100, our model takes 13,18,23,28 seconds respectively whereas other models take up to 40-85 seconds.

## 7 CONCLUSION

In Bangladesh, registered land maintenance and its frequent updating have proven to be a difficult undertaking. The general public has lost faith in the current systems. Many are not sure if anyone else's name is on the land in their name. And many people can't be sure who the real owner of the land is when they buy land? We have to go to the land office to register, and face various problems. That is why we have introduced a Blockchain based online land record system. In our system, people can register land very quickly without any problem. Updating our system with accurate information can quickly register land. One of the many benefits is that no one can change the transaction history. There will be no doubt about it, and no one will be able to show fake records even if they

want to. Thus, this Blockchain-based system proves that all matters of transfer of land ownership is very protective and it is essential for a corrupt country like us.

## References

1. Himani Mukne, Prathamesh Pai, Saish Raut, and Dayanand Ambawade. Land record management using hyperledger fabric and ipfs. In *2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, pages 1–8. IEEE, 2019.
2. Md Shariful Islam. Land verification system using blockchain technology in bangladesh. Nov 2019.
3. Kazi Masudul Alam, JM Ashfiqur Rahman, Anisha Tasnim, and Aysha Akther. A blockchain-based land title management system for bangladesh. *Journal of King Saud University-Computer and Information Sciences*, 2020.
4. Md Sakibul Islam, Fahmid Shahriar Iqbal, and Muhaimenul Islam. A novel framework for implementation of land registration and ownership management via blockchain in bangladesh. In *2020 IEEE Region 10 Symposium (TENSYMP)*, pages 859–862. IEEE, 2020.
5. Dongpo Zhang, Zhenyuan Zhang, Luan Chen, Shu Li, Qi Huang, and Yihong Liu. Blockchain technology hyperledger framework in the internet of energy. In *IOP Conference Series: Earth and Environmental Science*, volume 168, page 012043. IOP Publishing, 2018.
6. Vinay Thakur, MN Doja, Yogesh K Dwivedi, Tanvir Ahmad, and Ganesh Khadanga. Land records on blockchain for implementation of land titling in india. *International Journal of Information Management*, 52:101940, 2020.
7. Constantinos Papantoniou and Brian Hilton. Enterprise solutions criteria in the age of geoblockchain: Land ownership and supply chain. In *Proceedings of the 54th Hawaii International Conference on System Sciences*, page 5307, 2021.
8. Dylan Yaga, Peter Mell, Nik Roby, and Karen Scarfone. Blockchain technology overview. *arXiv preprint arXiv:1906.11078*, 2019.
9. Richa Sharma, Yugchhaya Galphat, Ekta Kithani, Jaya Tanwani, Bhavesh Mangnani, and Nikita Achhra. Digital land registry system using blockchain. *Available at SSRN 3866088*, 2021.
10. J Michael Graglia and Christopher Mellon. Blockchain and property in 2018: At the end of the beginning. *Innovations: Technology, Governance, Globalization*, 12(1-2):90–116, 2018.
11. Qassim Nasir, Ilham A Qasse, Manar Abu Talib, and Ali Bou Nassif. Performance analysis of hyperledger fabric platforms. *Security and Communication Networks*, 2018, 2018.
12. Saqib Ali, Guojun Wang, Bebo White, and Roger Leslie Cottrell. A blockchain-based decentralized data storage and access framework for pinger. In *2018 17th IEEE International Conference on Trust, Security and Privacy in Computing and Communications/12th IEEE International Conference on Big Data Science and Engineering (TrustCom/BigDataSE)*, pages 1303–1308. IEEE, 2018.
13. Hiroki Watanabe, Shigeru Fujimura, Atsushi Nakadaira, Yasuhiko Miyazaki, Akihito Akutsu, and Jay Kishigami. Blockchain contract: Securing a blockchain applied to smart contracts. In *2016 IEEE international conference on consumer electronics (ICCE)*, pages 467–468. IEEE, 2016.