Permissioned Blockchain-Based Solution to Document Processing in the Real Estate Industry

Vishalkumar Langaliya(✉) and Jaypalsinh A. Gohil

Department of Computer Application, Marwadi University, Rajkot 360003, Gujarat, India
vishalkumar.langaliya111484@marwadiuniversity.ac.in,
jaypalsinh.gohil@marwadieducation.edu.in

Abstract. For Blockchain Technology, Real Estate is a particularly excellent target since it has a complicated transaction process that is designed to prevent fraud and enable stringent ownership protection. The real estate industry demands these characteristics, and this is where blockchain excels. Blockchain Technology can be used to enhance System openness making it possible for regulators to identify and stop fraudulent activity. Blockchain technology and the fundamentals of the Indian real estate market are introduced in the first section of the article. The second section summarizes recent research in the area of interest and points out research gaps. The framework and suggested algorithms for document processing in the Indian real estate sector are shown in the third part. The implementation of the proposed algorithms with tools and technologies is suggested in the final section. Using the permission blockchain, the proposed algorithms can be put into practice as chain code. The suggested algorithm's ultimate purpose is to preserve transparency, record integrity, and trust factor in the targeted area to encourage openness, integrity, availability, and trust.

Keywords: Blockchain · Indian real estate · Chain code · Hyperledger fabric · Transaction processing

1 Introduction

1.1 Blockchain Technology

In 2008, Satoshi Nakamoto made the idea of distributed blockchains a reality. He modified the architecture by extending the chain without requiring new blocks to be signed by trustworthy parties. Multiple nodes retain a secure log of all data transfers, often known as transactions. Through a peer-to-peer network, each participant timestamps and validates each transaction. Without the necessity for a centralized authority, this is managed. Because of these developments, blockchains have evolved into the foundation of cryptocurrencies (Fig. 1).

A distributed database called a blockchain enables direct transactions between two entities without the requirement for a centralized authority[2]. This straightforward yet

S. Rajagopal et al. (Eds.): ASCIS 2022, CCIS 1760, pp. 217–231, 2022.
https://doi.org/10.1007/978-3-031-23095-0_16

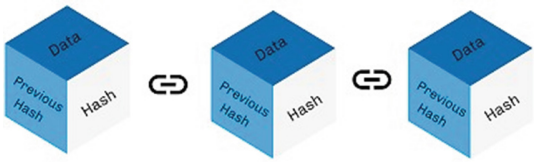

Fig. 1. Blockchain as a chain of blocks [1]

potent idea has broad ramifications for a variety of institutions, like banks, governments, and markets, to name a few. Any company or organization that relies on a centralized database as a competitive advantage could be disrupted by blockchain technology (Fig. 2).

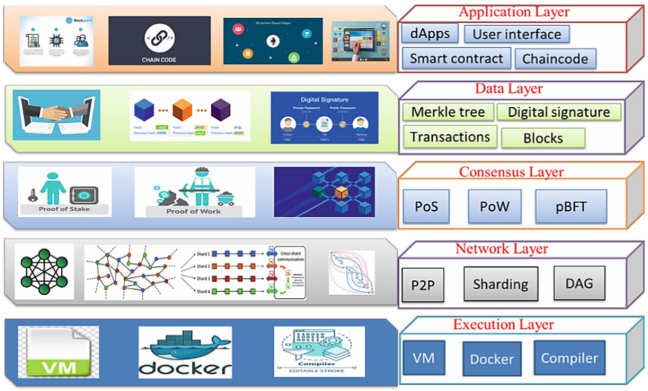

Fig. 2. Layered architecture of blockchain [3]

1.2 Indian Real Estate Sector

Real estate is defined as land, along with any buildings or structures on it, as well as the air surrounding it and the ground below it. A further name for it is real estate. Residential properties estate, business offices, public buildings, such as theatres, hotels, and restaurants, as well as retail establishments and industrial buildings, such as factories, are all included [4]. The purchase, selling, and construction of land, homes, and other structures are all aspects of real estate. Property owners, developers, designers, real estate professionals, renters, and buyers are some of the major stakeholders in the property industry. The real estate sector has gained importance in India since the country's economy was opened up (Fig. 3).

1.3 Impact of Blockchain Technology on the Indian Real Estate Sector

The real estate industry is currently adopting blockchain technology because it can streamline many of the industry's procedures. Documentation, recordkeeping, diligence,

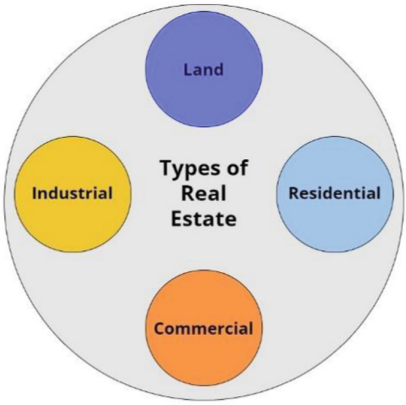

Fig. 3. Classification of real estate [5]

registration, and closure are all parts of these processes. Utilizing blockchain technology, the seller will provide the buyer with a password or private security key. The purchaser will have access to past property records, including ownership, upkeep payments, etc. The property buyer, after recognizing it, can also access the title documents, property tax, encumbrances, etc. Mortgages, payment transfers, and property registration may all be done extremely easily thanks to the digitization of data. As a result, blockchain technology streamlines accelerates, and improves the real estate process. The real estate industry would also gain from blockchain technology in many other ways, such as by eliminating title fraud, increasing tax revenue collection, eliminating corruption at the government level, reducing property disputes, lowering transaction costs due to the minimal use of intermediaries, and eliminating the need for physical storage of property papers.

Benefits of blockchain technology for the real estate industry

1. Blockchain makes it possible to view the data yet prevents tampering. This promotes data transparency and trust.
2. Because it will be "online," buyers will be able to simply search for real estateproperties online. Given the growth of internet portals and the demand for them, this will be extremely advantageous for the real estate industry.
3. Both speed and cost, which are big problems in the Indian real estate market, are solved by blockchain transactions.
4. In the blockchain, the usage of intermediaries is likewise constrained. This reduces unnecessary expenses and restricts fraud.

2 Related Research Work and Limitations

2.1 Summarization of Recent Research Work

In the year 2021, Fahim Ullah et al. [6] put their attention on a thorough design and engagement mechanism for real estate owners and users who are parties to a smart

contract. Along with a step-by-step process for founding and terminating smart contracts, a list of functions for starting, generating, altering, or dismissing a smart contract is provided. To do a comparison analysis, Rohan Bennett et al. [7] use many frameworks, such as the strategic grid analysis, technological readiness and maturity assessment, and adherence to business requirements. The outcomes show that the hybrid approach enables adherence to the requirements of the land dealing organization and that proofs-of-concept are a crucial stage in the expanding trajectory. The use of blockchain technology and smart contracts in real estate deals is given with a maturity model in the conclusion.

In the year 2020, According to Adarsh Kumar et al. [8], a blockchain data network and intelligent healthcare system Processes in Industry 4.0 Internet of things (IoT), industrial Internet of things (IIoT), machine intelligence, intelligent systems, cloud technology, edge devices, edge computing, etc. are examples of 4.0 processes that offer transparency, quick and easily accessible, security, efficiency, etc. The issue with the manual method is that the accuracy of the information about a property is not transparent. Toqeer Ali et al. [9] developed a Transparent and Trusted Property Registration System on Permissioned Blockchain to address this issue. For example, the individual in charge could misrepresent the manual process to the stakeholders by manipulating the data in the database. To help election stakeholders, understand the potential dangers, security threats, important required qualities, and weaknesses that could be associated with adopting blockchain e-voting for national elections, Olawande Daramola et al. [10] proposed blockchain e-voting architecture was utilized as a basis. The study discovered that internal vote tampering and numerous security vulnerabilities may be avoided using blockchain electronic voting.

In the year 2019, It outlines concerns with the present land recordkeeping process, such as a lack of accountability, inconsistent data sets with many government departments referencing the same parcel of property, and delays, as well as how Blockchain Technology can be used to address these problems. The development of a system using Blockchain technology for land titling is also illustrated by Vinay Thakura et al. [11]. This technology will provide legitimate and definitive ownership rights and make land titles tamper-proof. The study suggests exploiting Blockchain's intrinsic profits, with a focus on smart contracts. Every transaction will be recorded by the system and securely documented, regardless of whether it concerns the selling of a property, an inheritance, a court order, the acquisition of land, etc.

Using the free software permissioned blockchain design architecture Hyperledger fabric, an experimental prototype was created in 2018 by Mayank Raikwar et al. [12]. They discussed the key design criteria and associated design ideas before encoding several insurance processes as smart contracts. Numerous tests were run to evaluate the framework's performance and the security of the suggested design and transactions centered on a blockchain-enabled platform. To build a blockchain-based electronic voting system, Friorik P. Hjalmarsson et al. [13] propose a fresh approach that addresses some of the flaws in existing systems and investigates some of the popular blockchain frameworks. They revealed a blockchain-based electronic voting system that safeguards voters' privacy while facilitating safe and convenient voting.

Blockchain and smart contracts are presented by Ioannis Karamitsos et al. [14] for the real estate industry. After presenting a complete design of a smart contract, a use case

for leasing out homes and companies is considered. They offer a method for designing smart contracts that pave the door for the development of several Blockchain use cases. Comprehensive state finite processes and functions are defined for a specific use case that significantly contributes to the real estate domain.

2.2 Research Gap

We concentrated on the Systemic Literature Review of recent research conducted from 2018 to 2021 during the study and prepared a Proportional and Inclusive Review Analysis of Block Chain Applications in Different Domains [15]. According to a recent analysis, only a small number of industries, including the health sector, the insurance sector, the e-voting sector, and the land sector, have adopted blockchain technology. Future applications of blockchain technology with smart contracts include many untapped markets. The processing of real estate paperwork in traditional India is centralized, necessitating the obligatory involvement of an intermediary, and it lacks transparency, integrity, accessibility, and confidence. Additionally, the system lacks certain sophisticated business logic that may make it reliable and safe.

3 Proposed Research Work

In the field of Indian Real Estate Document Processing, the proposed framework will be used to address many issues, such as third-party trust, security, and integrity. Government agencies would handle and store Indian Real Estate Document Processing data using the proposed Hyperledger Fabric, a permissioned blockchain to process documents including sale deeds and mortgages. Participants in the transaction include the seller, buyer, mortgage agency, and insurance authority, while peers in the transaction include the registration authority, district magistrate (collector), court, and municipal authority. We are using permission blockchain rather than blockchain since the documents and data used in Indian Real Estate Document Processing are confidential. Direct negotiations between the seller and the buyer are an option for real estate transactions. They are equipped to launch blockchain transactions.

For fundamental operations, we developed three algorithms. The property registration process has one with business logic, the mortgage registration process has another with business logic, and the mortgage release procedure has a third with business processing. We advise using IPFS to store processed documents (InterPlanetary File System). The suggested model archives attribute such as security, privacy, and integrity. Additionally, it eliminates the chance of a single point of failure.

3.1 Designed Framework and Components

The suggested framework's three main, fundamental elements are listed below (Fig. 4).

- **PEERS -**Registration Authority, District Magistrate (Collector), Court, and Municipality Authority
- **PARTICIPANTS -** Seller, buyer, mortgage agency, and insurance authority

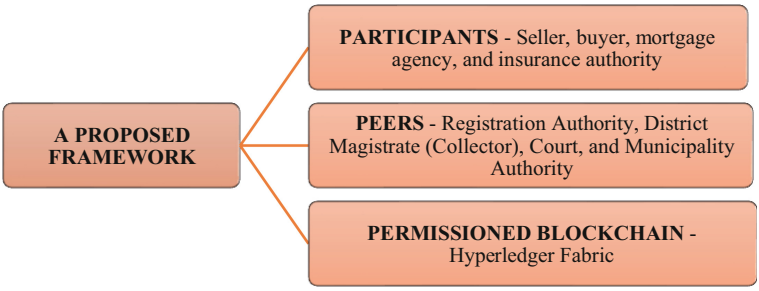

Fig. 4. Fundamental elements of the suggested framework

- **PERMISSIONED BLOCKCHAIN -** Hyperledger Fabric

1. Peers

   The registration authority's main services include adding new property registrations, transacting real estate, transferring ownership, issuing deed titles, and giving forth information about real estate and ownership. The District Magistrate is examining the property's legal component. The municipal authorities confirm the type of property and its condition; for instance, when registering an apartment, it is confirmed that the flat is finished and ready for registration.
2. Participant

   Any seller or buyer participating in the proposed framework is a direct user participant. The purchaser or vender may be merely the owner's authorized agent rather than the real owner of the property. Users include other organizations that authorize loans, insure properties, and approve mortgages by checking client information such as property ownership, type of property, and so on. These organizations include loan agencies/banks, insurance, and mortgage agencies.
3. Permissioned Blockchain

   It is a blockchain with limited network participation. The need of the government for control over blockchain network membership is therefore satisfied. Data, however, are controlled by multiple organizations. The most recent data set is kept in each peer's ledger. The blockchain is based on Hyperledger Fabric, which executes Smart Contracts (Chain code) to store and make accessible user-accessible data on property transactions. Owners of real estate are also given title deeds by executing a certain Chain code. The business logic that will be used to provide the service is contained in the chain code.
4. IPFS

   The Interplanetary File System is a peer-to-peer connection and distributed file system technology that enables data storage and dissemination (IPFS). Each file in the global namespace that links all computing devices is uniquely identified by IPFS through the use of content-addressing. In contrast to a centrally maintained server, IPFS is based on a decentralized system of user operators that each keep a fraction of the entire data. This results in a resilient data storage and sharing system. There is a cryptographically generated hash value for each item of data on IPFS. It

uses this one-of-a-kind hash to identify the data that is stored there. In IPFS, data is separated from transactions, which lowers communication and compute costs while maintaining privacy [16]. Due to the safe storage method offered by the IPFS protocol, it's a viable option for maintaining title deed records [17] (Fig. 5).

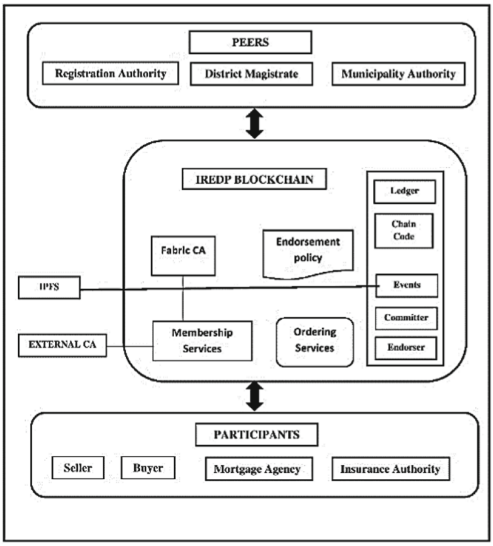

Fig. 5. Core architecture of the suggested framework

3.2 Core Transaction Process Flow

The three crucial processes for processing Indian real estate documents are the subject of the proposed framework:

1. The Registration of Real Estate

   Both the buyer and the seller agree to participate in the property registration process. This transaction will be registered at the registration office with the appropriate legal papers. The documents will be examined by the authorities, who will then approve the sale deed documents after receiving the required stamp duty fees (Fig. 6).

2. Registration Process for Mortgages

   To mortgage the property, the owner must apply the mortgage registration process. After the registrar authorities have confirmed the property's ownership, the mortgage will be registered and the mortgage registration notice will be sent (Fig. 7).

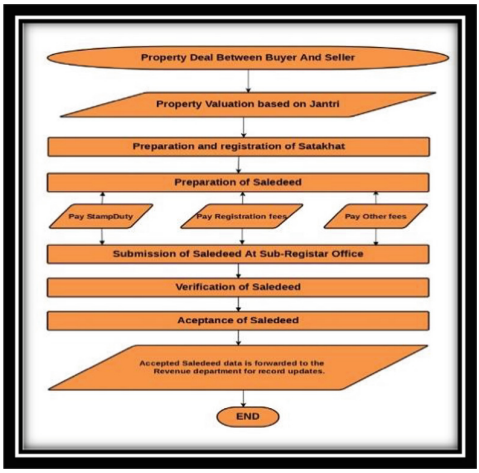

Fig. 6. Real estate registration process flow

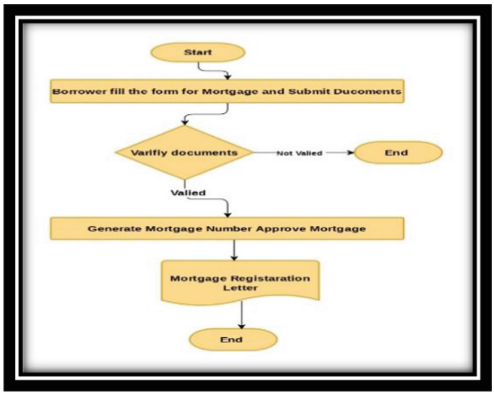

Fig. 7. Mortgage registration process flow

3. The Mortgage Release Procedure

The property owner must apply at the registrar's office without a form from a linked organization, like a bank, to have the mortgage freed. The Registrar Authority issues the mortgage letter to the owner after making sure that previous records are accurate and that no uncompleted forms are there (Fig. 8).

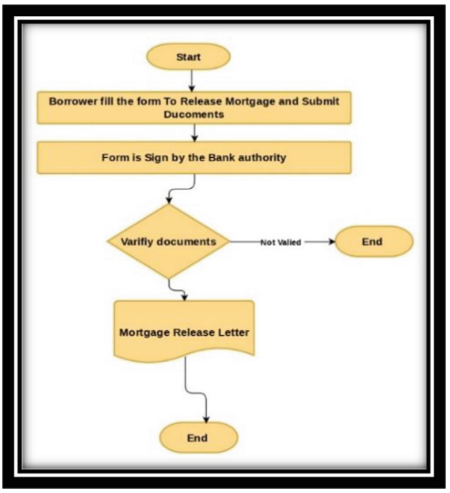

Fig. 8. Mortgage release process flow

3.3 Proposed Algorithms

Algorithm-1 for New Property Registration

Input Data: enroll-no, sign, Smart-Contract-id, transaction-proposal, owner-info, property-info, property-completion-info, Stamp duty-fee-paid

Result: Insert the Final Transaction in Blockchain Database.

Step 1: **Participant verification and authentication**

```
if (enroll-no-exists=False OR sign_valid=False) then
        abort request;
end if
```

Step 2: Access Verification of Participants

```
if (enroll-no having the ability to invoke-Smart-Contract-id=False)  then
        REJECT
end if
```

Step 3: Examining the format and looking for duplicates Transaction

```
if (Verify_whether_proposal_is_in_desired_format  =False) then
        REJECT
end if
```

```
if (Verify_whether_transaction_is_Duplicate_or_Original =False) then
        REJECT
end if
```

Step-4: Approval for New Property Registration Transaction from all authorities

a) Approval from the Municipal Authority

```
if (property-owner-info-is-correct OR Construction-plan-verified
        OR property-construction-completion-certificate-issued =False) then
            REJECT
 Else
    transaction-approved-by-Municipal-Authority=True;
    update world state; (Key value: Municipal-Authority-Validation=True)
end if
```

b) **Approval from the District-Magistrate-Authority**

```
If (Any-pettion-against-subjected-property==true) then
      REJECT
 else
      transaction-approved-by-District-Magistrate-Authority=True;
          update world state; (Key value: District-Magistrate-Authority-
Validation=True)
end if
```

c) Approval from the District-Court-Authority

```
if(Any-Stay-order-against-subjected-property==true) then
                REJECT
 else
      transaction-approved-by-District-Court-Authority=True;
      update world state; (Key value: District-Court-Authority-
          Validation=True)
end if
```

d) Approval from the Registration-Authority

```
if (owner==FALSE OR Saledeed-transact-property-amount>owner-
property-amount OR property-valuation==FALSE) then
                        REJECT

else if (Stamp duty-fee-paid=True || Stampduty-fee-paid-
amount=evaluated-fee) then
      transaction-approved-by-Registration-Authority=True
      update world state;
          (Key value: Registration-Authority- Validation=True, Fee-
paid=True,
          owner=new-owner)
       Insert transaction to the ledger;
 else
       REJECT;
```

end if

Step-5: Final Sale deed transaction execution

if key-value (Registration-Authority- Validation=True, Municipal- Authority-Validation=True, District-Court-Authority-Validation=True, District-Megistrate-Authority-Validation=True,Fee-paid=True, owner-new-owner) then

Issue-title-deed and store to IPFS;
IPFS-address=location of title-deed on IPFS;
Calculate hash_deed=hash (Issued-title-deed);
Update world state (key-value: hash_title_deed = hash_deed, IPFS_location= IPFS-address);
else
REJECT
End If

Algorithm-2 for Mortgage Registration Process

Input Data: enroll-no, sign, Smart-Contract-id, transaction-proposal, owner-info, property-info, mortgage_details

Result: Insert the Final Transaction in Blockchain Database.

Step 1: **Participant verification and authentication**

```
if (enroll-no-exists=False OR sign_valid=False) then
        abort request;
end if
```

Step 2: Access Verification of Participants

```
if (enroll-no having the ability to invoke-Smart-Contract-id=False)  then
        REJECT
end if
```

Step 3: Verification of Mortgage details

```
if (mortgage_fees_paid=True  AND property_details = True) then
        verify-property-details-with-records;
        update world state (key-value: verification-property-details  =true);
 else
        REJECT
 end if
```

Step-4: Final Mortgage Registration transaction execution

```
if key-value (Fee-paid=True, verification-property-details  =true) then

        Issue-mortgage and store to IPFS;
        IPFS-address=location of the mortgage on IPFS;
        Calculate hash_deed=hash (Issued-mortgage);
        Update world state
        (key-value:  hash_mortgage_id =  hash_mortgage, IPFS_location =
IPFS-address);
 else
        REJECT
 end if
```

Algorithm -3 for Mortgage Process Process

Input Data: enroll-no, sign, Smart-Contract-id, transaction-proposal, owner-info, property-info, mortgage_details

Result: Insert the Final Transaction in Blockchain Database.

Step-1: **Participant verification and authentication**

```
if (enroll-no-exists=False OR sign_valid=False) then
        abort request;
end if
```

Step 2: Access Verification of Participants

```
if (enroll-no having the ability to invoke-Smart-Contract-id=False)  then
        REJECT
end if
```

Step 3: Verification of Mortgage Registration details

```
if (owner_details=True) then
        verify-mortgage_details-with-records;
        update world state (key-value: mortgage-release-status =true);
 else
        REJECT
 end if
```

Step-4: Final Mortgage Release transaction execution

```
if key-value (mortgage-release-status =true) then
        Issue-mortgage-release and store to IPFS;
        IPFS-address=location of mortgage-release on IPFS;
        Calculate hash_deed=hash(Issued-mortgage-release);
        Update world state
         (key-value:  hash_mortgage_release-id  =  hash_mortgage-release,
IPFS_location= IPFS-address);
else
                REJECT
end if
```

3.4 Deployment

To implement the provided framework and analysis, we constructed a mock small basic form of design with the bare lowest configuration. For deployment purposes, we made use of the following technical specification. Ubuntu v16.04.6 LTS, Node.js, curl, Docker, and NPM SDK. Hyperledger Fabric.

4 Conclusion and Future Scope

At the outset of this post, we discussed the importance of emerging technologies like blockchain. Additionally, we've outlined the six-layer architecture of the most crucial elements of blockchain technology and described their structure. We also talked about

Indian real estate, which is the country's most significant and influential industry, and provided a brief description of the various kinds of real estate that are offered there. The article's middle half discusses ongoing research as well as the significance of blockchain in the Indian real estate industry. Finally, we have shown the research hole that blockchain technology can fill. The article's proposed architecture for processing Indian real estate documents is a permissioned blockchain system with smart contracts. Peers, participants, and components are described, and a flow diagram is used to illustrate the three main processes' progress. An effective algorithm that can be used to implement the first three stages has been proposed. The article's conclusion lists the technical requirements for deployment. Even though the suggested framework has already been put into practice, a comparison analysis can still be done in the future to enhance the functionality of the system.

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