International Journal of Future Generation Communication and Networking
Vol. 13, No. 1, (2020), pp. 1136-1149

Blockchain Based Land Document Digitization and Secured Storage

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Abstract

Land related fraud is a huge problem in India. Many cases are reported about forgery and credit related frauds pertaining to land. Therefore we propose the usage of Blockchain and Smart Contract technologies to counter three major problems. One is to solve the problem of forgery that is each land document will be unique and no two owners can exist for the same piece of land. The second is to use the smart contracts for ownership transfer or in other words, the sale of land. Smart contracts work together with blockchain making the process even more secure and tamper proof. The entire process of sale happens digitally through smart contract capturing the terms of sale. Finally, we can counter the credit related frauds pertaining to the land by specifying a credit score for the land which dynamically changes with the credit borrowed, thus preventing the owner from borrowing loan that exceeds the value of land and also conceal any existing monetary liabilities.

Keywords*:Blockchain, Immutable Record, Smart Contract, Hash*.

1.Introduction:

Blockchain technology was first introduced in 2008 by Satoshi Nakamoto. It was the founding technology initially used in Bitcoin, a digital currency. Blockchain technology is a public ledger that is digitized and decentralized that is it follows Distributed Ledger Technology (DLT) that is used in all digital transactions through crypto currencies. It allows multiple authoritative domains that lack trust on each other to take rational decisions by making them cooperate coordinate and collaborate by acting as a platform for decentralized computations and time sharing. Blockchain is a data structure that contains records of transaction and provides transparency and security in a decentralized

environment. It can also be considered to be a chain of transactional records that consists of no user holding authority over the blockchain. The blockchain is available for all the participants on the network because of it being in a distributed fashion. We can verify the originality of the transaction by verifying the digital signature. It's implausible to forge data in a blockchain as it involves encryption.

The data in the blockchain is in the digital format thus making it available to all the users in the network. Since a consensus is maintained between all the participating nodes in the network about the data available in the blockchain, it prevents forgery of the records maintained in the blockchain.

Blockchain makes use of the concept of hashing; Hash is a sequence of string of alphanumeric that is generated by a hash function. Hash function is a mathematical function that takes as input a variable number of characters and produces an output with fixed number of characters. Even a smallest change made to the characters would result in a completely new hash thus helping us detect forgery. In blockchain each block consists of its hash and the hash of the previous block. The name blockchain arises from its structure where individual records that are known as blocks are linked to a single list called a chain. Technically, non-trusted peers in the network order the chain of blocks in the blockchain.

For verifying the authenticity of a transaction in the blockchain we make use of digital signature, a digital signature is generated by using the private and public keys. We authorize the transaction only after the authentication through the keys. Miners solve the complicated mathematical problems and arrive at a consensus between the participating nodes in the network; the resulting solution is called the Proof-of-Work. When a new block gets created it consists of the timestamp of creation, hash of the previous block and the public key of the receiver and all these information is broadcasted in the network. This marks the start of the validation process, the new block is created only when a consensus has been attained between the majorities of the nodes in the network. When a new block is appended to the chain then the existing copies of the information in the block gets updated. We make use of the shared, distributed ledger to keep track and record transactions of tangible and intangible records where tangible records refer to a house, a car, cash, land and intangible record refers to intellectual properties such as patents, copyrights, etc. Thus blockchain reduces the risk and cost involved in these transactions.

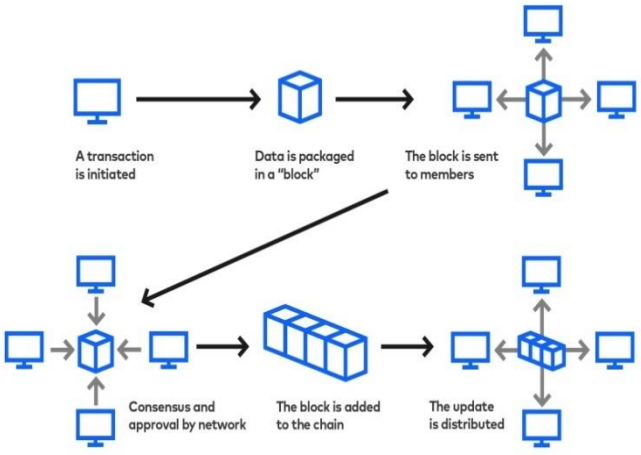

Figure 1. Blockchain- An Overview

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Figure 1 gives you an overall impression on how a block is added into the blockchain.

1.1.Blockchain Structure

1.1.1: Block

Each block consists of a unique identification number. Blocks are records that together make up the blockchain. They record the recent transaction that has occurred.

1.1.2: Chain

Chain is the element that connects two different blocks in a blockchain. The connection is established using the hash that is generated using some of the hashing algorithms such as SHA1 or SHA2 that generate the hash value by considering the data in the previous block.

1.1.3: Node

Data storage centres of the blockchain are called as node. Depending on the requirements of the chain any device such as a computer or a laptop or a server acts as node. The verified nodes add the transaction to the blockchain after verification. History of the transactions are stored in each of the nodes thus we could say that each node consists of an entire blockchain theoretically.

Functions performed by nodes:

- The transaction is accepted or declined based on the validity
- The records of the transactions are stored as they happen
- The transactions that are valid are broadcasted throughout the network so that other nodes could synchronise with the chain

1.1.4: Network

Network consists of all the nodes connected by the chain; it acts as the home to all the elements that are present in the blockchain.

1.2.Smart Contracts

Smart contracts run on the blockchain. It captures both the parties involved in the transaction so that none of them deny the ownership. The smart contract excludes the need of a third party's involvement in the transaction. They are the foundation for the decentralized network. Using smart contracts we can trade money, property, shares, etc transparently with ease without any brokerage or third party involvement. Smart contracts are executed only after a consensus has been achieved. It acts as a notary to prove the ownership of the document that is involved in the transaction. It was with the advent of bitcoin and other cryptocurrencies that transactions can be made over the web without the need of any third party authenticator such as a bank. The entire process is made secure and tamper resistant with the help of Proof-of-Work that we saw earlier. In the blockchain we can save the transaction with the smart contract together. Smart contracts consist of two main attributes, they are state and value. Once the contract terms are agreed and signed by the parties it is broadcasted in the blockchain network where the miners validate it and store it. The miners on receiving create or execution request, they receive the parameters from trusted source execute the contract in local Sand Box. If they meet a condition which is specified as if-else, then the corresponding action is triggered.

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2. Existing Land Registration Process

- Both the parties involved in the trade of land negotiate the terms of sale
- If the buyer is going to get loan from a bank then the seller needs to get a certificate stating that the land is not caught in any legal or monetary liabilities
- Both the parties get legal opinion on the draft of the sale deed that is prepared
- After verifying the sale deed, the stamp duty as arrived by the government's guidelines is paid to the treasury and stamp paper is bought
- After the agreed amount is paid to the seller by the buyer the deal is sealed by signing the sale deed
- The deed is registered at the Sub-Registrar's office after validation and verification

3. Literature Survey

The contribution of various scholars is studied for survey and analysing the merits and demerits in order to enhance the consequences for making the system work better.

Vinay Thakur et al [1] proposed adopting blockchain for managing the records pertaining to land in India. It points out the various problems like unaccountability, less transparency and incongruous data sets with the various departments of the government related to the land record management. It also points out the tremendous delay in the existing system. He proposed the use of Blockchain for land titling, to provide right of ownership and make it fool proof.

Ingo Weber et al [2] proposed an architecture for multi-tenant blockchain based system to assure data integrity while preserving data privacy and performance isolation. Though there are difficulties in constructing the multi-tenant blockchain based architecture considering data and performance isolation. Firstly, the data of one tenant must be not available for another tenant to read, also that tenants having higher workload must not affect the read and write operation of the other tenants. Secondly the architecture must be scalable for each tenant and also with the number of tenants. This architecture maintains individual architecture for each tenant's data and smart contracts.

U.M.Ramya et al [10] proposed a system to reduce forgery in land registry using blockchain technology. The system makes use of a private permissioned blockchain called Multichain for land registration. Multichain provides a simple API, command line interface and supports Linux, Windows and Mac servers. As the system uses a private permissioned blockchain it is not necessary to use an algorithm such as Proof-of-Work to show that transactions are taking place between nodes and new blocks are added to the chain. A drawback is that the technology is still developing and it's effectuation is not cheap. Also a minor change on the original document would change the hash which makes verification tedious.

Aravind Ramachandran et al [6] suggested that blockchain can be used to promote the collection of data provenance and verify them accordingly. The proposed system incorporates smart contracts and open provenance model (OPM) to record data transactions that are deemed as immutable. The privacy protection of the proposed system for the provenance data is accomplished by hashing and encryption. A user accepted by the owner can only see the changes made to an inferred document ID by accessing the event log. The major drawback faced here is the owner is able to give access to users who may misuse their access privilege and they might pose a threat to the credibility of the proposed system.

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Shuai Wang et al [7] devised a Blockchain-Enabled Smart Contracts architecture, where smart contracts are pacts facilitate the negotiation and implementation of digital contracts without the need of a third party user. One of the key benefits of smart contracts is that the code of smart contracts is recorded on the blockchain making them immutable. But the proposed architecture faces a severe drawback, in the presence of irreversible bugs present in the smart contract that contains a bug which cannot be changed.

4. Issues in the Existing Systems

- The land records existing today are ambiguous and not well maintained. There are discrepancies in the data they hold when compared to reality. This is one of the critical challenges faced by the government.
- When the documents are submitted, they need to be verified before sealing the transaction. Therefore a team is set up to verify the authenticity of the documents submitted by verifying it with the concerned issuing authority.
- It is cumbersome and time consuming.
- Prone to human errors.
- Inability to detect forgery.
- No system to keep track of the credit on the land.
- Involvement of the third parties.
- Concealment and manipulation of details during registration.

5. Proposed System

The proposed system provides security, confidentiality and saves time and manual labour involved in the sale of property by carrying it out digitally without any intermediate entity

- The owner of the land registers themselves with the Registry by providing the necessary details
- The Registry approves their request for user ID creation. The KYC of the owner is done by verifying the government ID proofs submitted by the owner
- Once the IDs are verified the registry uploads the document pertaining to the land of the user. The document is encrypted by hashing by using SHA256 algorithm
- A digital form containing the ownership details such as the name of the owner, address, date of birth are filled by the registry. An additional detail that we use to counter forgery is the latitude and longitude coordinates of the corresponding land which is used as a key to detect forgery
- A credit score for the land is assigned so that we can prevent loan/credit related fraud at the bank
- The details are stored in the blockchain along with the hash of the land document by the Registry
- The digital copy of the document can be viewed by the owner by using the QR code
- The QR code is unique to every document generated by the central registry

Thus we have digitized and securely stored the land document.

5.1. Process of sale of land using Smart Contracts

The proposed system uses smart contracts and solves the problems of the current system.

- The land owner/seller registers himself with the central registry by creating an account.

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- Similarly the buyer registers himself with the central registry.
- The buyer verifies the land document's authenticity by requesting the QR code pertaining to the land from the seller.
- Once it's verified, the buyer shows interest to buy and starts the negotiation.
- After a consensus has been achieved between the two parties, the seller sends a signed digital form containing the negotiation terms, land's price value and the sale deed to the buyer.
- The buyer signs the digital form sent by the seller after verifying the form contents and the sale deed and the system sends the signed digital form and sale deed to the seller.
- The seller notifies the registry about the sale by sending the digital form and the sale deed.
- The smart contract consists of the signed digital form and the ownership transfer is facilitated once the digital signatures of both the buyer and seller are authenticated by the Central Registry.
- The buyer pays the necessary stamp duty to the treasury digitally.
- The registry verifies the terms and documentation and carries out the transfer of ownership digitally.

6. System Architecture

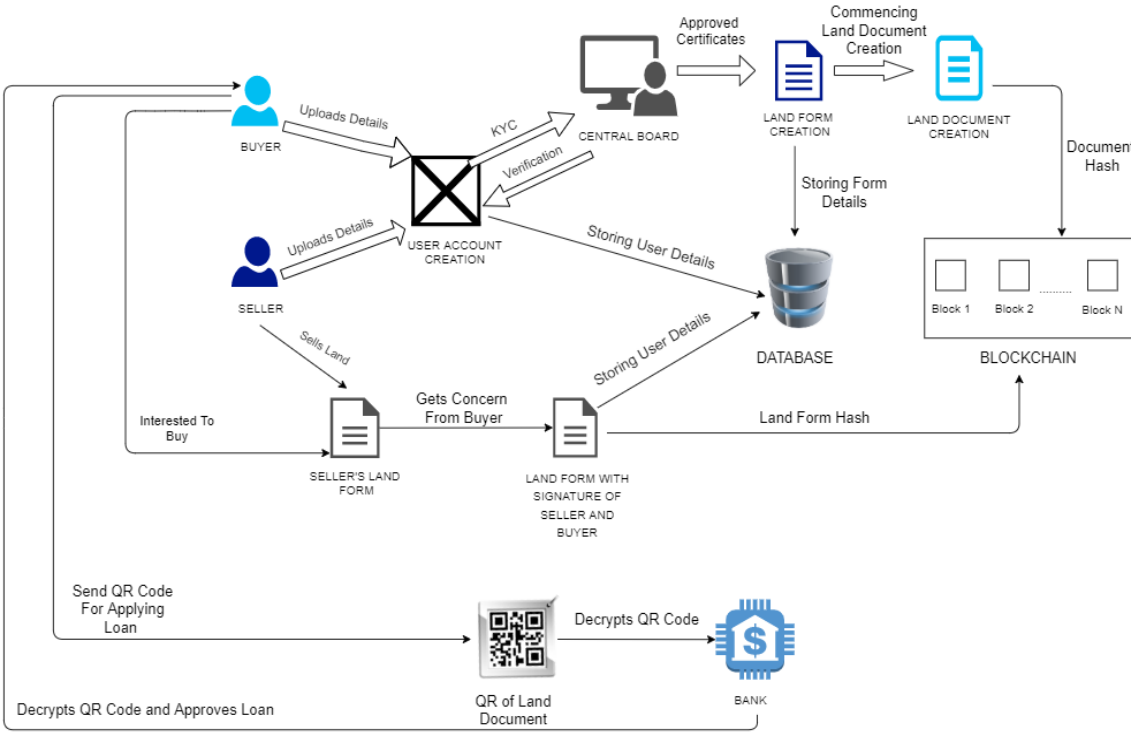

Figure 2. System Architecture

Figure 2 represents the entire function of the proposed system.

6.1. User Registration and Authentication

In this module, the user needs to register into the application and a request will be sent to the Registry server for authentication. Unless the Registry server approves the request,

user cannot login into his account. When the Registry server approves the request, a User ID will be generated and the user can login into his account.

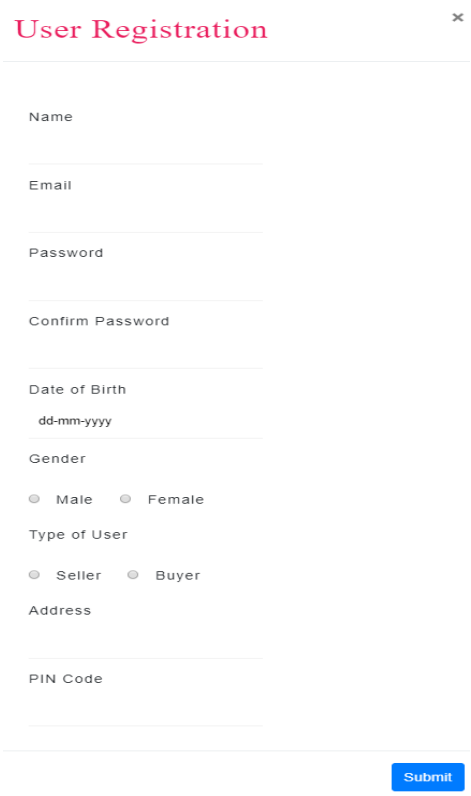

Figure 3. Form prompting the user to enter details

Figure 3 shows a form that asks the user to enter his details for the creation of a user account.

6.2. User Upload Certificate

After a user login into his account he needs to upload certificates namely pan card, Aadhar card, voter ID etc., to the Registry server for KYC verification. The Registry server will review the certificates and accept or decline the certificates. If the Registry server accepts the KYC details, the registry creates a digital form containing the user's land details and uploads the land document in image format after taking a hash.

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Figure 4. KYC details of the user displayed after entering

Figure 4 shows that the KYC proof documents are uploaded by the user.

6.3. Sale and Owner change

The buyer and seller negotiate and share the terms of negotiation. The seller generates a digital form which contains the price of the land and the necessary land details. Also the seller uploads a sale deed containing the legal terms of the sale. The seller signs the digital form presenting his consent and sends the digital form with the sale deed to the buyer.

The buyer verifies the seller's digital form and the sale deed and signs the digital form expressing his consent before sending it to the seller. Figure 5 shows the digital form signed by both the seller and buyer. Now the seller requests the ownership transfer to the Central Registry. The smart contract captures the digital form and the sale deed as the contract terms and the approval of the digital signatures from the Central Registry acts as the conditions to facilitate the ownership transfer. Once the Central Registry verifies the legal terms, it initiates the transfer of ownership for the particular land.

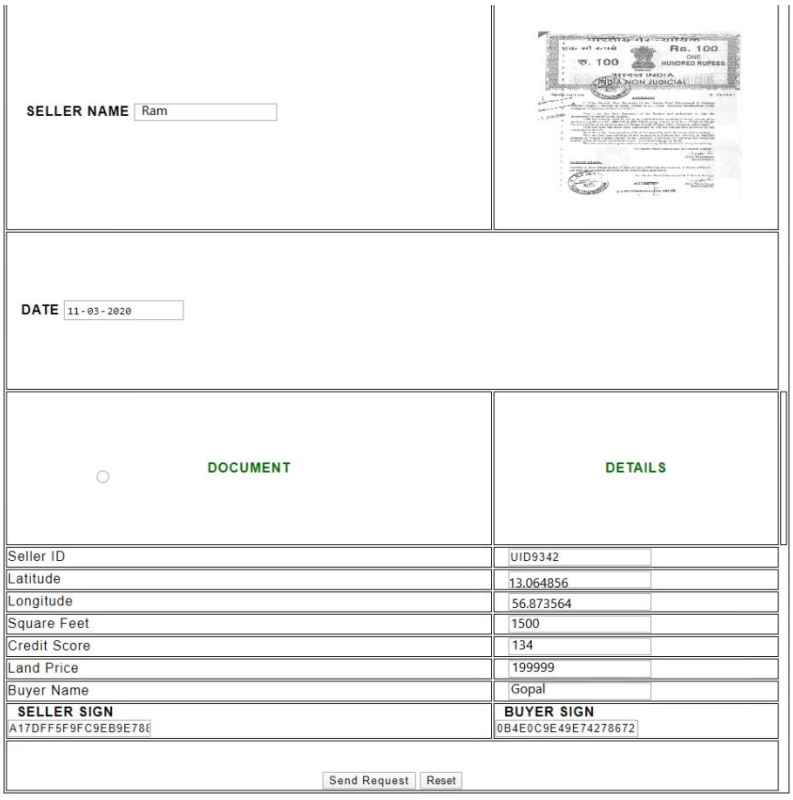

Figure 5. Digital form containing the digital signatures of both buyer and seller

6.4. QR Request and Response from Verification Authority

If a user wants to apply for bank loan user will send a request to the bank admin. User forwards the QR code to the bank authority and if land details are correct bank admin will

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issue the loan. Figure 6 shows that after decrypting the land document of the bank loan user, the admin will be able to approve the bank loan.

Figure 6. After Decryption- The land document to which the loan is to be approved for.

7. Implementation

Due to the lack of proper maintenance of the land records, there have been several litigations, scams and property disputes over land ownership. Hence, a highly secure and a digital department has to be set up, for the proper maintenance of land records. The main aim is to computerise all land records, including mutations, improving transparency in the land record maintenance system, digitise maps and surveys, updation of all settlement records and minimization of the scope of land disputes and also to provide clear titles of land ownership that could be monitored easily by government officials, for facilitating quicker transactions.

Due to the lack of transparency and secured maintenance of land records, numerous cases are reported on property scam such as forgery and credit fraud on the land. Therefore it requires the Registry to maintain the land records in a streamlined and tamper resistant fashion. The proposed Blockchain architecture will have land and identities of parties involved as assets and the transactions done will be through smart contracts.

A web application is created where an user registers by providing the required details, there is a portal for the central registry where the user details are sent. The central registry authorizes the user id creation. The user can login into the portal using their respective credentials which is validated using JavaScript. The owner requests the registry to digitize the land records. The Central Registry uploads the document as an image file and uses SHA256 to take a hash of it. The central registry also creates a form comprising of the details of the land records such as the owner name, address, square feet of the land and credit scored assigned to it. These details are converted into a JSON array and passed into the python blockchain using JSON objects.

The python blockchain works as a map where the values are stored as key value pairs. The previous block is hashed and that hash is stored in the next block, this way the blocks are connected with hash keys that are completely unique. The transaction will happen only if the hash is correct. If a small change is done, a different hash would be generated causing the entire network to get disrupted. This indicates an alteration has been done and so forgery could be detected easily. The sale and transfer of ownership is carried out using

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the smart contract where the buyer and seller negotiate the terms of sale. The smart contract consists of the signed digital form and the sale deed, these two can be considered as contract terms and the conditions to trigger the ownership transfer are the digital signatures of both the parties. Once the central registry verifies the terms and the digital signatures, it authorizes the transfer of ownership. The central registry appends a new block with the status of the current owner marked to the buyer.

8. Performance Analysis

8.1 Time Taken for Block Creation

We are comparing the time taken for the creation of a single block for the hashes of land document and the digital form signed by both the parties respectively. The results of the above mentioned analysis are shown in the following figure 7.

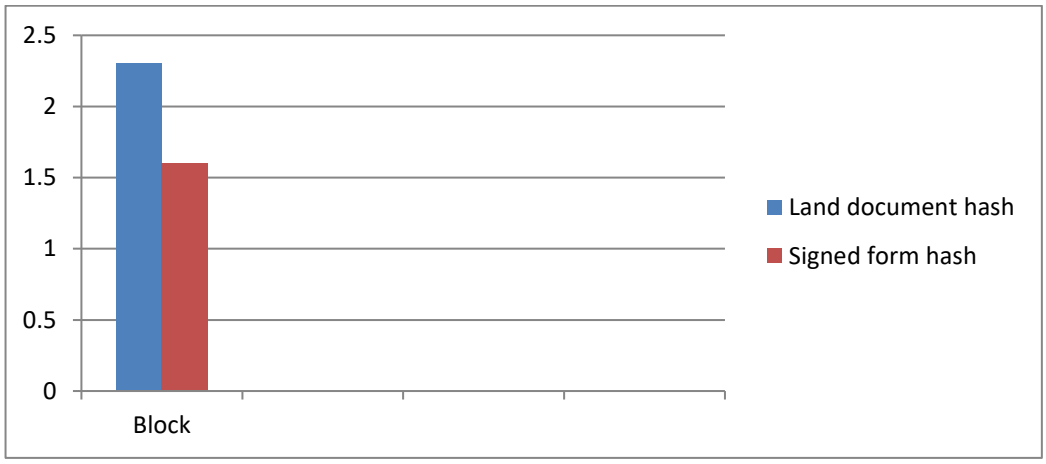

Figure 7. Time taken for Block Creation

Hash	Time taken for block creation (in seconds)
Land Document	2.3
Signed form	1.7

Table 1. Time taken for block creation of the above file hashes

8.2 Analysis of Encryption and Decryption Time of Land Document

Now we are going to compare the time taken for the encryption and the decryption of the images of the land document which is going to be approved by the bank for loan. We are going to use RSA algorithm for this process and this is going to be applied for images of different sizes.

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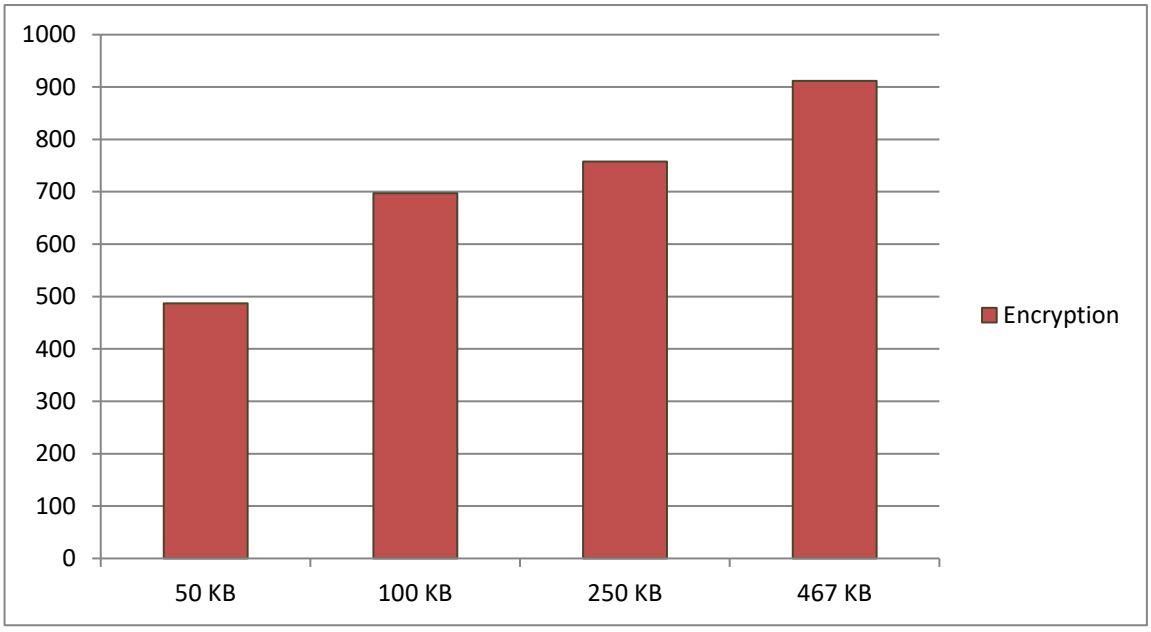

Figure 8. Time Taken for Encryption

File Size	Time taken for Encryption (in milliseconds)
50 KB	487
100 KB	697
250 KB	758
467 KB	912

Table 2. Time Taken for Encrypting the Images

Figure 8, shows the time taken for encryption for images of different sizes and we are able to see that the time taken for encryption increases with increase in file size. Figure 9, shows the time taken for decryption for images of different sizes. From comparing the time taken for both encryption and decryption, we are able to conclude that the time taken for decryption is much lesser than the time taken for encryption

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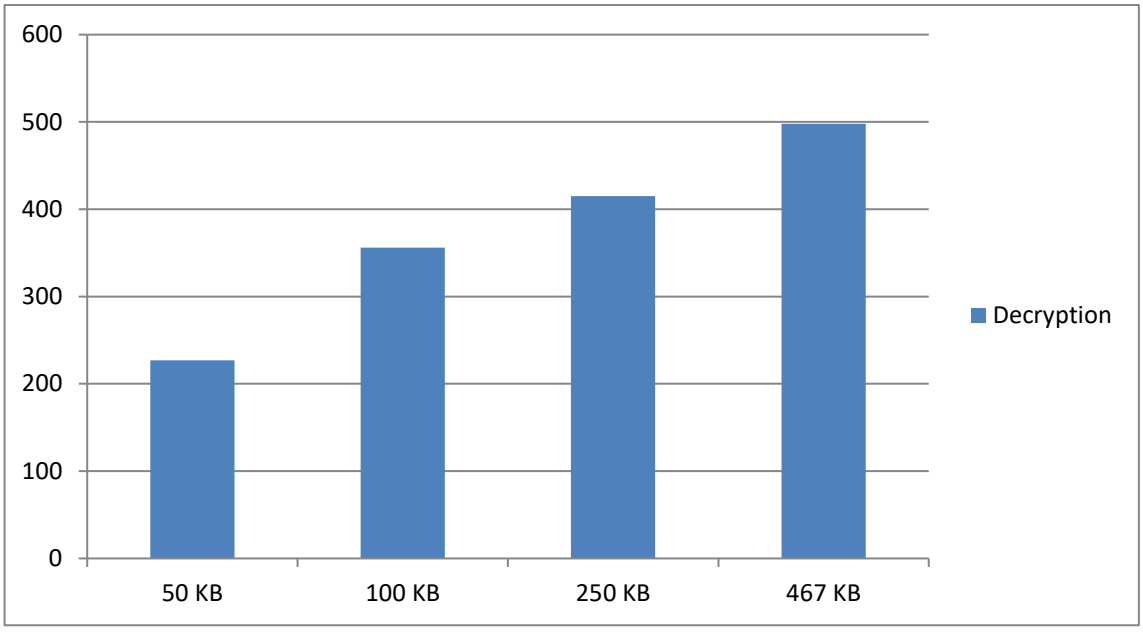

Figure 9. Time taken for Decryption

File Size	Time taken for Decryption (in milliseconds)
50 KB	227
100 KB	356
250 KB	415
467 KB	498

Table 3. Time taken for decrypting the images of the above mentioned sizes

9. Result and Future Works

In this paper, we have proposed the idea of improved and digitized the Central Registry process using Blockchain technology as a platform to build the underlying trust infrastructure. Using the blockchain technology will bring transparency and prevent frauds. It enhances data security and authenticity of land records. Blockchain could change our perception about trusting records. The solution will also increase confidence in the government and make the overall customer experience less cumbersome. Most importantly it will enhance data security and ensure authenticity of land records. But the

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development of blockchain in government sectors is a debatable topic due to the interlinking of various records under different departments and also owing to the immutability aspect of the blockchain extra care must be taken to not make mistakes during the uploading process. In future this idea could be extended with the usage of AI to identify the fraud.

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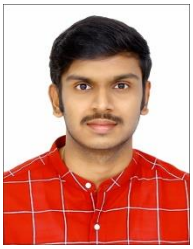

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