Land Ownership Transfer Management System with Blockchain Technology: Perspective Bangladesh

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Abstract: Land ownership transfer procedure is started from the legal land owner, buyer and deed writer sides. Inaccessibility of legal ownership documents of the land makes a scope of illegitimate land transfer ownership even in registration office. To prevent illegal registration, this research proposes Blockchain based land ownership transfer process. The proposed system is similar to the present land registration system that is initiated from the landowner and buyer through deed-writer and finalized by the assistant commissioner of land (ACL). All the stakeholders like landowner, buyer, deed-writer and ACL are the parts of Blockchain. Here all the transactions are visible to everyone in the Blockchain and the buyer, deed-writer and ACL can check the present status of the land immediately. If someone in the Blockchain try to illegal transaction, all the records are saved permanently and transaction is blocked. So, every activity is visible to every stakeholder in the chain and prevents illegal transaction easily. Even if legal transaction is committed then every chain is updated by the new information. So, any illegitimate transaction is not possible. Although, the primary stakeholders are compromised mistakenly, the final approver (ACL) can stop the transaction after taking consent from the owner present physically in from of the ACL. Under this research, corresponding Blockchain software is designed and implemented with dummy data and tested. It can prevent illegal transaction successfully.

IndexTerms - **Blockchain, Land Records, Transactions, Deed Writer, Registrar, Sub-Registrar, Proof of Work, Hashing, Secure Transactions, Cadastral Survey, Records of Rights.**

INTRODUCTION

Land administration system in Bangladesh is developed by the Britishers in British colonial era [3]. Following the partition of India in 1947, East Pakistan, became part of Pakistan. The land administration system remains in place, continuing the tradition of maintaining Khatians and deed registrations through a manual process. The system was still based on paperwork and bureaucratic procedures. After independent in 1971, when we became Bangladesh, the majority of the administrative system including land administrative needed to be restructured. The land administration system continued to rely heavily on traditional methods, prioritizing manual recordkeeping and bureaucratic processes, despite the newfound autonomy. The present system is the final stage of historical practices. It involves key entities such as the Department of Land Records and Surveys (DLRS) and Regional Administration and Registration Office. However, this system has several challenges, like bureaucratic complexities, delays in processes, the risk of fraud, and limited transparency, particularly in rural areas.

In Bangladesh, the land record system comprises of the preparation and maintenance of the Record of Rights (RoR), often referred to as Khatian, and the property transfer deed registration [2]. There are three sets of documents which are RoR containing mauza-maps, mutated RoR and registration deed. Directorate of Land Record and Survey (DLRS), Regional Administration and Registration Office are the three offices that prepared and maintained these documents. These offices are fully independent of one another and responsible for classifying and quantifying landholding as well as protecting property rights. The preparation of RoR involves two steps. Preparing a mauza-map that highlights the location, area, and land properties is the first step. The second step specifies the land's ownership, area and character of land through Khatian. This is how a RoR is made of. All districts in Bangladesh have already completed the Cadastral Survey (CS) except the three hill districts. The current survey is essentially a Revisional Survey. During CS, it focuses on updating the maps and Khatians. However, a full new survey is carried out rather than a revisional one in places where topographical changes amount to more than one third or when the landmass is made up of recently accreted land. The function of preparing RoRs for each and every piece of land has been placed on the DLRS. Using of various loopholes, land sharks cooperate with officials to falsify papers, subsequently claiming fake ownership or involving in violent land grabs result civil disputes in the judicial system [1]. For this, victims have to suffer in the long run. For the average person, the amount of time and money lost in the process is intolerable. Though the government has begun the process of digitizing RoR, it is still in the

beginning stages of development and its use case is restricted to archive purposes alone. So, it is necessary to come up with a sophisticated system that can be easily accomplish with theongoing digitization efforts along with current land related transactions with better level of integrity and authenticity. The main issue with the existing system is that information is scattered among different government departments that are not suitably coordinated, and corrupted individuals can collude to alter legal papers. The key problem with the current system is that information is fragmented in multiple government offices that are not synchronized very well and corrupted people can conspire to modify legal documents. In this case, a centralized system will not be sufficient to handle various frauds related to land titling.

Distributed ledger technology (DLT) can provide some important solutions to this problem. DLT is a database model, where several nodes are connected in a peer-to-peer network, and each node stores the complete copy of the ledger [5]. The Blockchain is a distributed digital ledger—a digital record of transactions or data held in several locations on a computer network which is immutable and unchangeable. Anyone can always rely on the ledger to be correct since it is immutable and the distributed nature of the Blockchain guards against network intrusions. A "block" is the unit of storage for every record, transaction and information of any persons all land details on a ledger. Every block of data is connected to and dependent upon the data in the block before it, creating a chain of transactions across time. Thus, the term "BLOCKCHAIN" [4].

The nature of a land title is attached to its previous history of ownership and how it has been changed over time. The integrity of land ownership is maintained by this chain of papers, which is consistent with the core principle of Blockchain technology. In the case of Blockchain, every newly added block maintains a chain with its previous block and it can be traced back to the root node [1]. This property can be applied to the land ownership transfer scenario. On the other hand, once a new block is accepted, it is very difficult to change the previous blocks that again make it immutable. This feature is also helpful in managing the possibility of document fabrication by those in positions of power. Also, every node present in the Blockchain network maintains a complete copy of the full ledger which ensures transparency [1]. Since every nation has a unique land title administration model based on its culture and history, it's necessary to use modern technology, like Blockchain, to identify a suitable solution for Bangladesh's land RoR maintenance. The main contributions of this paper are the following:

- Explain the existing land ownership transfer and titling system with current progress and problems.
- Describe the necessary entities that involves in this process.
- Identify the most important entities.
- The first phase of our proposed model is a private Blockchain where Deed Writers become part of our system. In the second phase we try to add all the BS Records in our Blockchain. It is also the main chain of our system. If a transaction occurs, the third phase, then a new block is mined where the new created BS Record and information of the transaction is recorded in that block and become part of our Blockchain. The second phase and third phase is a public and hybrid Blockchain.
- Our experimental results demonstrate that the proposed system reduces the number of required travels whereas improves data accessibility, cost of operations, and reliability over the current model.

The main objective of this paper is to make a successful transaction and record those properly and securely in Blockchain.

EXISTING SYSTEM
A. Initial Agreement:
In Bangladesh, the buyer's and seller's agreement on sale and purchase of the property is the first step of the land ownership transfer system. Both parties need to ensure that the terms and conditions of the sale, are mutually agreed upon.

- Identify Buyer and Seller: Purchasing and selling of the property are agreed upon by both parties.
- Verify Property Details: It is very important to check all the property details such as the title, ownership, boundaries and any potential encumbrance. This verification makes sure that the property is free of disputes and legally transparent for transfer.
- Obtain No Objection Certificate (NOC): Depending on the jurisdiction and the nature of the property, a No Objection Certificate (NOC) might be required from relevant authorities such as local municipal corporations or development authorities. This certificate indicates that there are no legal objections to the sale of the property.

B. Preparation of Legal Documents:
If the initial agreement is placed then the next step is to prepare the legal documents.

- Draft Sale Agreement: A sale agreements needs to be prepared strictly and clearly that includes all the terms and conditions of the sale such as sale price, payment schedule, and any other relevant clauses. This is known as a preliminary contract before the final sale deed is executed.
- Sign Agreement: In the presence of witnesses, both the buyer and the seller must sign into the agreement paper. This formalizes the agreement and makes the legal bonding.

C. Preparation of Legal Documents:
Stamp duty is a tax paid to the government on the legal recognition of certain documents, including property transactions.

- Calculate Stamp Duty: The value of the property is used to calculate the Stamp Duty. Based on the location and type of property Stamp Duty can be varied. It is very important to calculate the correct Stamp Duty.
- Purchase Stamp Paper: After calculating the Stamp Duty, Stamp Paper must be collected from the authority. It is proof that one paid the Stamp Duty.
- Affix Stamp Duty: The collected stamp paper must be affixed with the sale deed. This is essential for making sure that the sale deed is recognized by the legal authorities
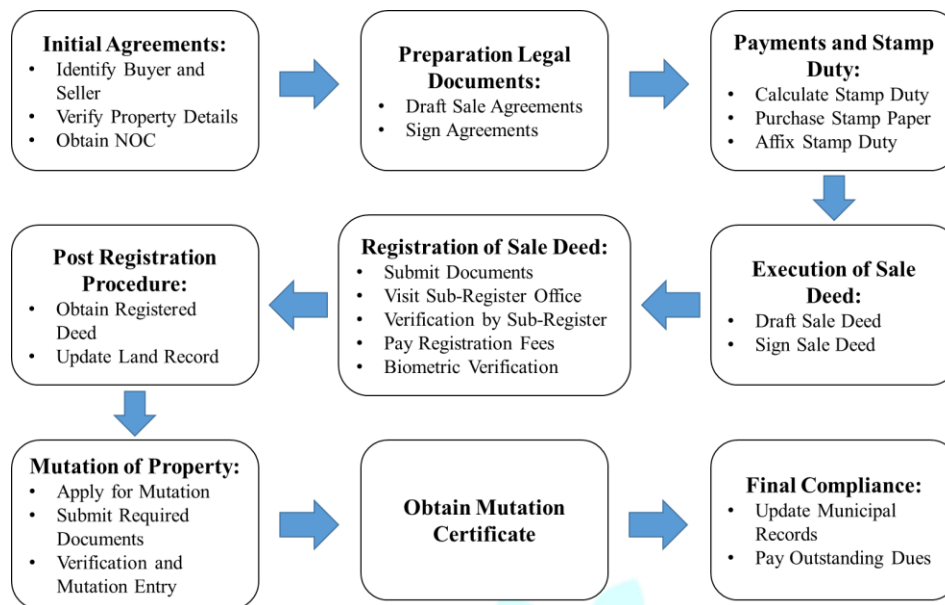
Figure 1: Existing System.

D. Execution of Sale Deed:

- Draft Sale Deed: The sale deed which include all necessary details and terms from the sale agreement, details of the transaction, property description, sale price, and the obligations of both parties etc. should be clearly drafted by a professional legal person.
- Sign Sale Deed: The buyer and seller must sign the sale deed in the presence of two witnesses.

E. Registration of Sale Deed:

At this point, the signed sale deed must be registered from the local Sub-Registrar's office to complete the legal transfer of ownership. Registration is a legal requirement in Bangladesh. It ensures that the transaction is recognized by the government.

- Submit Documents for Registration: The documents that need for registration are:sale deed, identity proofs of buyer and seller, NOC (if applicable), proof of payment of stamp duty, previous title deeds.
- Visit Sub-Registrar Office: Both the buyer and the seller, along with witnesses, must visit the Sub-Registrar's office to present the documents for registration.
- Verification by Sub-Registrar: The Sub-Registrar will verify the documents to ensure that all legal requirements are met and that there are no encumbrances on the property.
- Pay Registration Fees: The buyer must pay the required registration fees at the Sub-Registrar's office. The fees are usually a percentage of the property value.
- Biometric Verification: Both parties will complete biometric verification. This step is mandatory for verifying the identity of the parties involved in the transaction.

F. Post-Registration Procedures:

After the registration of sale deed, there are some more procedures that need to be done to finalize the transfer of ownership.

- Obtain Registered Deed: Buyer need to collect the registered sale deed from the Sub-Registrar's office.
- Update Land Records: The buyer must apply to update the land record. For this he/she needs to go to the local land revenue office or municipal authority. This step ensures that the new ownership is recorded in the government's land records.

G. Mutation of Property:

Mutation, also known as "NAMJARI", is to inform the government about the latest change of the ownership and enable the government to collect land tax from the new owner.

- Apply for Mutation: The buyer must submit an application for the mutation of property in their name at the local land revenue office.
- Submit Required Documents: The documents that are required for the mutation process: Registered sale deed, Mutation application form, Identity proofs, Tax clearance certificates (if applicable).
- Verification and Mutation Entry: The land revenue officer will verify the documents and update the land records to reflect the new ownership.

H. Obtain Mutation Certificate:

After the mutation process is completed, the buyer must collect the mutation certificate from the local land revenue office. This certificate serves as proof that the land records have been updated to reflect the new ownership.

I. Final Compliance:

The final step involves ensuring that all records and dues are updated and cleared.

- Update Municipal Records: The buyer must ensure that the property records are updated with the local municipal corporation for property tax purposes. This step ensures that the new owner is recognized for all municipal services and tax liabilities.
- Pay Outstanding Dues: The buyer should clear any outstanding property taxes or dues to avoid any legal complications in the future.

RELATED WORKS:

Kazi Masudul Alam [1] argued on an elaborated system for managing Land title in Bangladesh harnessing the power of the Blockchain technology to overcome the problems of the current one. It is important to understand that the current titling of land poses many challenges, as the authors elaborate. The proposed Blockchain based solution will help in making guarantees to synchronize the data, have transparency, easy access and the record management forms an unchangeable part along with being much faster and cost effective. In the proposed model the authors speak about phased adoption. The first phase is the Public Blockchain ledger with a mobile based UI (User Interference) considering the use of mobile and internet is common in Bangladesh. For standard handovers in RoR, the ledger performs the role of accommodating the time stamp and being transparent to prevent fraud. In the second Phase a Hybrid Blockchain is developed to design for maintaining reliable PKI (Public Key Infrastructure) for the interaction of concerned parties. Another obvious pillar to address is the lack of digital literacy where the masses are slowly introduced to the values of Blockchain and a permissioned private Blockchain ledger is implemented. This phase entails the use of offices belonging to the public and private domain in the Blockchain mining process. A Full Hybrid Blockchain is in the third or the final phase, in the proposed system. In the model, the digitized documents are stored in the IPFS (InterPlanetary File System), which makes the changes somewhat hard to make and also difficult to manipulate the files in the process. This approach is believed to provide substantial change on the current state of land titling in the country; that is, simplifying and making the information more accessible. In conclusion, the proposed phased Blockchain adoption model underpinning this paper and designed in accordance with the Bangladeshi setting suggests that the existing convoluted method of exerting institutional reforms in the land titling process can be significantly revamped.

There is also a paper that claims to provide an in-depth evaluation of how Blockchain technology could revolutionize Land records and Registers in India [7]. It outlines the major issues related to the existing solution such as absence of clear and logical structure of data, problems associated with poor accountable and transparent and maintenance and delays in Land records maintenance and registrations. This paper is on these challenges and suggests that Blockchain technology can serve as a solution to them. The current systems do not have the confidence of the public in India making the citizen in doubt regarding the legal ownership of their land even though they may possess the sale deed. This is because it's almost difficult for potential buyers not to have uncertainties about the sellers' rightful ownership of saleable assets. The paper uses an analysis of the Kerala floods disaster, which saw paper records washed away, as an example, positing that Blockchain could have been a possible solution in this case. Due to the characteristic of decentralization and the techniques of establishing a digital ledger of multiple transactional records, typical of block chain; the system holds numerous benefits. It guarantees the integrity of documents that are integrated and observable by everyone throughout the process. This would have a positive effect on ownership and decrease on fraudulences, and assist in land utilization and the economic development. Also, the integrated and secured land information system corresponds with the SDGs mainly in terms of nurturing strong institutions that support the cause of peace and justice. The proposed system builds on Blockchain's fundamental strengths to incorporate smart contracts to document each exchange through trade, family inheritance, court direction, and land acquisition. This contributes to the continuous creation of an up-to-date, openly recorded, and easily audited database, thus eliminating double ownership of property and claiming history. This system minimizes the cases of forgery and disagreements as well as the time and costs of performing the transaction, and makes way for a perfect Land Titling system with title guarantee in India. The paper also outlines the limitations of its research and recommendations for future studies. It notes that due to the decentralized nature of land record data they are in different levels and departments; thus, implies that it can be difficult to use Blockchain system at the center. That is why it suggests that states should pay more attention to the strengthening and improvement of the land parcel boundaries as well as the land parcel shares demarcation. It highlights the importance of redesigning the business processes and implementing standard operating procedures at the state level since the administration of land is a state matter in India. The paper also points out at the fact that there is no general and standardized Blockchain architecture and the call for landmark regulations to govern the disputes arising out of the implementation of Blockchains. It also reveals the possibility of implementing Blockchain with another contemporary technology, artificial intelligence to improve the response rate, safety, speed and transparency of the land management ecosystem.

Table 1: Related Works Shortly.

Author	Contribution	Limitations
Kazi Masudul Alam [1]	• Incremental Adoption Model. • Public and private Blockchain Integration. • Pilot Implementation. • Cost and time efficiency.	• Highlights potential scalability issues. • Relies heavily on government involvement. • Public awareness and education.
Vinay Thakur [7]	• Comprehensive review. • Identification of key challenges. • Potential solutions to address these challenges. • Case studies from various countries.	• Land parcel boundaries are not consistently updated or clearly demarcated. • There is no centralized server to manage land records across various departments. • With population growth, the load and number of transactions on the Blockchain system will increase, posing scalability challenges. • Does not fully address the potential risks and uncertainties associated with the adoption of emerging Blockchain technologies.

There is another paper, published by the American International University Bangladesh, which provided an insight into the use of Blockchain technology in the transfer and registration of land and property [6]. This paper presents an overview of the applications of Blockchain in the various contexts, but with especial focus on how it can be applied to the field of Land registration. The authors

advance a model on a permissioned Blockchain, that is, Hyper-Ledger to solve these problems. This Blockchain-based system is intended for the storage of data in relation to land records, maintaining security and at the same time cutting interference from stakeholders in the middlemen. Furthermore, it presents other simple algorithms which are essential for execution of this system. The introduced system involves several parties mainly administrative authorities, land registry offices, and even banks which helps make it efficient easy to implement even for those who have no knowledge of the Blockchain system.

PROPOSED SYSTEM

Our proposed system has three essential stages. The initial step involves the entry of the deed writer into the Blockchain system. The second phase entails the entry of survey Khatian details. Finally, the third step encompasses the process of transferring ownership. In Figure 2, we can see the simplified architecture of our system. The "Deed Writer Chain" and "BS Record Chain" is a public Blockchain. Actually, "BS Record Chain" is not an actual chain rather it is a part of "Main Chain". In "Main Chain", every block contains two more blocks into it. These two blocks are BS Record block and Transaction block.

A. Phase-1: Deed Writer Entry in Blockchain (Public Blockchain)

As mentioned earlier in our described method, the first process is a rather important one, the entry of a deed writer into the Blockchain system. The deed writer equally has a very crucial role to play in the entire transaction process in the proposed system since they complete all the space requiring conveyance of transactional information. Figure 3 describes the flows about how a deed writer becomes a part in our Blockchain. However, at first the 'Bangladesh Deed Writer Act, 2014' has to be brought into force and
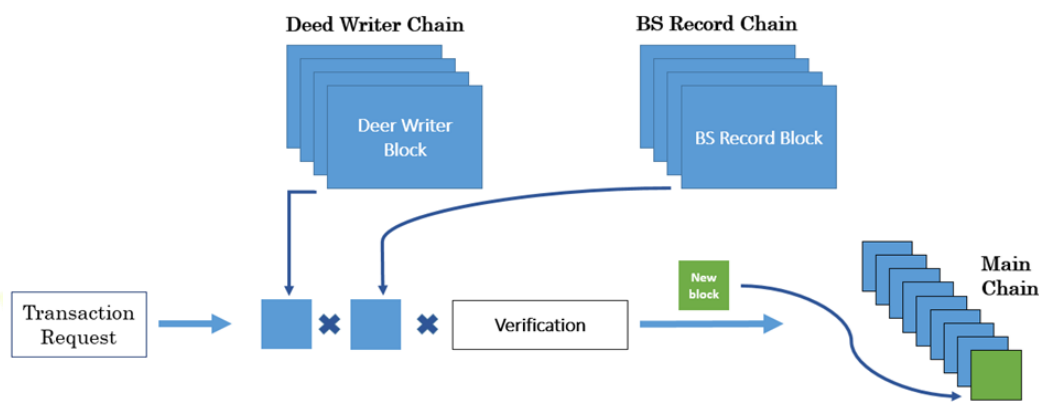
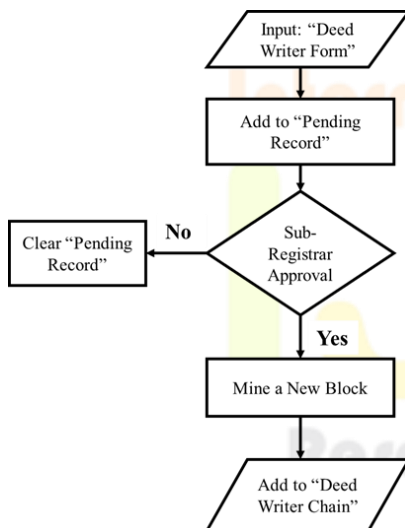Figure 2: Simplified Architecture.

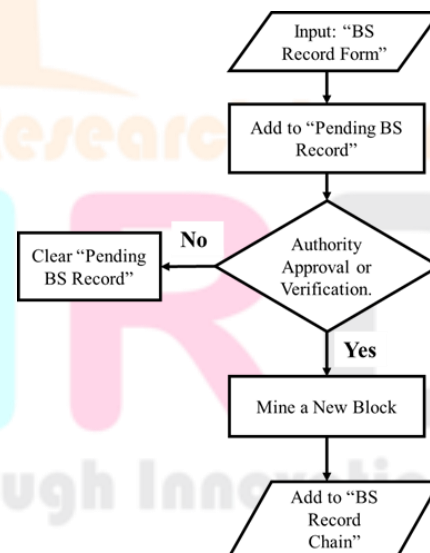Figure 3: Storing Deed Writer Information.

Figure 4: Storing BS Record to Our Blockchain.

the initial requirements of this rightful and legal official must be met. After those, the deed writer has to fill passing a 'Deed Writer Entry Form' whereby they will join Blockchain. It is then sent and forwarded to the Sub Registrar for confirmation and further consent. The Sub Registrar as a matter of detail ensures that all documents submitted by the respective parties are genuine and valid. If there is something wrong with the details, the Sub Registrar cancels the application, informing the deed writer of its denial. On the other hand, if everything is ok the Sub Registrar approves the application and the deed writer is accorded access to the Blockchain system. The deed writer gets the permission to participate in various types of transactions. It is a public Blockchain. So anyone who is finding a deed writer can easily go to the deed writer site where he can find every deed writer with all of this qualification, personal information and working experience. Also, he/she can search with a particular name or number to find his/her specific deed writer and verify the information.

B.   Phase-2: Survey Khatian Entry or BS Record Entry (Public Blockchain)

Moving to the next phase, the 'Survey Khatian Entry' step is controlled and maintained by the Bangladesh Land Administration. They conduct the surveys and input the information into the blockchain. As illustrated in Figure 4, we can see the process of how a survey record is added to our blockchain. The latest survey in our country is the Bangladesh Survey (BS) survey. Initially, the administration inputs the data by filling out an information form, which is then placed into the "Pending BS Record" array. At this stage, the information undergoes verification by the Land Administrative Authority. Upon verification, a new block is mined and the information is added to the chain. If any misinformation is found, the authority erases the incorrect data, rechecks it, and corrects the information before proceeding again. A significant limitation in our proposed system arises if mistakes occur in recording "BS Records," such as incorrect changes to the Khatian number or other details. Since the data has already been uploaded to the immutable blockchain, addressing these errors can be challenging. However, solutions do exist. For instance, a new corrected entry can be appended to the blockchain, providing an editable trail of corrections. This ensures that the original incorrect data remains unaltered for transparency, while the correct information is recorded and easily accessible.

C.   Phase-3: Ownership Transfer Process (Hybrid Blockchain)

This is the final phase of our chain. The private "Deed Writer Chain" and the public "BS Record Chain" is a part of this phase, makes this phase a hybrid Blockchain because two more public Blockchain are linked with it. The manual and the proposed digitalize model will go parallel in this phase. Figure 5 shows the block diagram of this phase. Here, first the buyer and seller meet with each other manually and make a sale agreement. This is exactly like the existing process. They both signed the sale agreement and in the present of two witnesses. When the buyer verifies the property details there's come the digital part. In our Blockchain all the details of the property is already recorded in "BS record Chain". In the "BS Record Chain" all the previous record of that particular property is available. So the buyer can easily avoid the complexity of documents verification. Also, the fraudulence and making fake documents are totally eradicated by this transparent and immutable system. One can get the actual information by sitting his home with a device which has internet connection. He or she should not worry about the authentication of the legal information. In Figure 5, buyer and seller collaboration means the manual agreement or the signed agreement between them.

Here comes a little bit chance from the manual process in our proposed system. We make the deed writer a crucial part of our system. We elaborate his duty more except just writing the deeds. In the proposed system deed writer is only the third party that involves to make a transaction. At this stage, buyer and seller find a deed writer who must have to be a part in our "Deed Writer Chain". As mention earlier in phase 1, finding a deed writer is an easy step. He or she just need to go to the deed writer chain site where he/she can find all the information regarding deed writer. From there, he/she can select a deed writer and appoint him to do the necessary work. The deed writer then fill up the form regarding buyer and seller information. The buyer and seller must be a part in our "BS Record Chain" so that when deed writer provide the information about them, it automatically verifies with the recorded information in "BS Record Chain". So any false information regarding buyer and seller makes the transaction impossible to proceed further. Actually, this section authenticates the buyer and seller. It can be a limitation also. The major limitation is the stamp duty. In our proposed system it should done manually. We will discuss these in the limitation section briefly.

Then the deed writer fills the form on land information which is connected with "BS Record Chain". So, he/she have to give the correct information otherwise further proceeding will not be possible. Now as the documents is digitalized and the verification of deed writer, buyer and seller is also digitalized with Blockchain so the complexities and the fraudulence are eradicated.

After all of this verification, the buyer and seller with deed writer and witnesses go to the Sub-Registrar office to register the sale deed. It is a mixture of manual and proposed digitalize system. They manually go to the Sub-Register office and have to submit only two things, the signed sale deed, stamp papers. All other information regarding this transaction already went to the Sub-Registrar office when deed writer filled the forms. Sub-Registrar verify all the documents in his computer instantly, take the biometric verification, check the sale deed and stamp paper manually. Then if he/she finds all the things in order, he approves the transaction and give the buyer and seller the registered deed. When Sub-Register approves the transaction, new BS Record and Transaction Information are created and recorded in a newly mined block. So we can say that Sub-Register is actually a miner. By creating and recording this information, mutation also automatically done by the Sub-Register which again reduce the steps of existing process. Finally, Sub-Registrar provide a mutation certificate and complete the transaction process. Now there is a scenario, what if the Sub-Registrar delay the process willfully. So, when a transaction request occurs, the Sub-Registrar has only 15 days to react on it. If he/she delay more than 15 days then he/she will notify to show the cause of it. Also, if Sub-Registrar disapproved the request, he/she has to write down the cause of it clearly and properly.

D.   Hashing Algorithm, Proof of Work and Mining

To create a hash several functions are used where the main function involves the use of a cryptographic algorithm SHA-256 which is implemented by 'sha256'. This algorithm utilizes the inputs from previous block hashes in addition to the actual data enclosed in the block and a number called nonce and then scrambles it into a fixed number of characters and symbols called the hash. The processes are depicted graphically in the Figure 6 below. In this method, it string together the hash of the previous block, the data of the current block and the nonce. After that the ID is concatenated with a user defined string and the SHA-256 algorithm is applied to generate a hash. The 'challange' component in the context of the 'PoW' method takes form in the efficacious hardworking of miners. The increase in the value of a parameter referred to as the nonce, and the hashing of information from the block until it meets certain requirements, such as the number of leading zeros in the hash. This process is very demanding in terms of computation and thus to arrive at the status where one can get a valid hash requires a lot of computation and time. The Proof of Work required, can be variable, so that an average of blocks is generated per time spam. When a miner (in this case Sub-Registrar) finds a nonce that results to a valid hash value, this can be attested as proof that computational work has been done and the new block with the new hash is broadcasted and assimilated into the Blockchain. This detailed hashing system and the linked 'Proof of Work' is one of the key components that secure and make the Blockchain a valid and easy to substantiate decentralized and trust less transactions ledger.
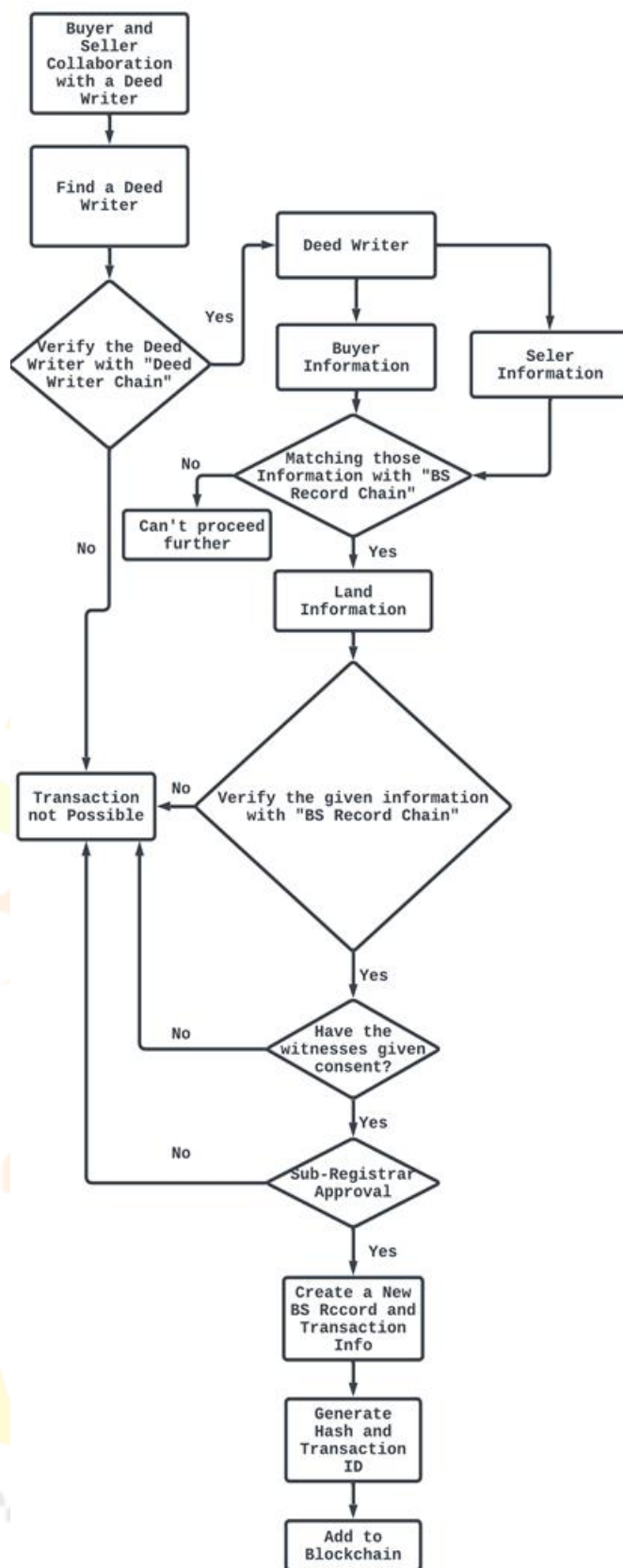
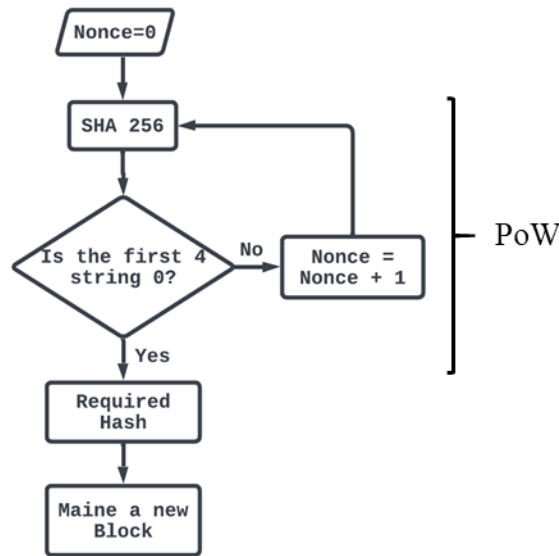Figure 5: Process of a Transaction.
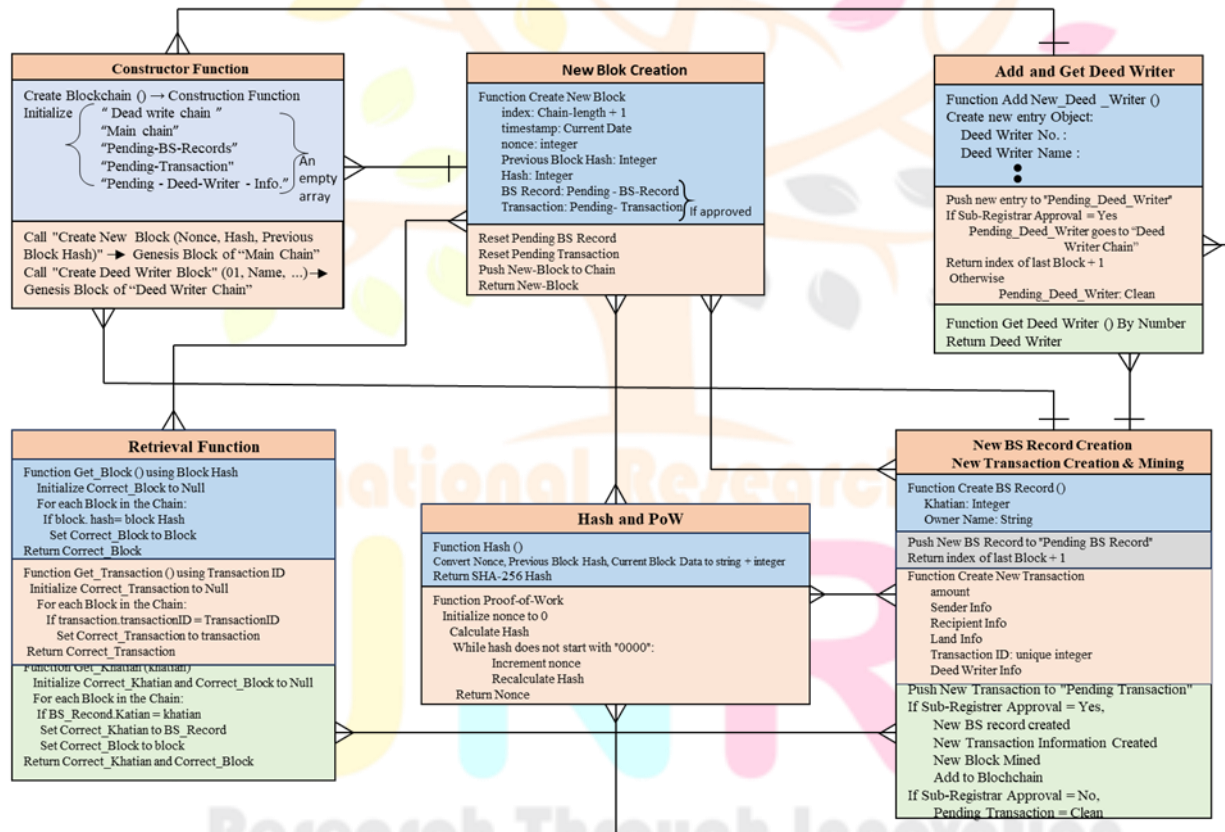
Figure 6: Generating Hash, PoW and Mining.

ALGORITHMIC BREAKDOWN AND ENTITY RELATION DIAGRAM:

Figure 7: Entity Relation Diagram.

Figure 7 shows the ER diagram that how our code actually works. The Blockchain system starts with the Blockchain constructor function, initializing 'Deed Writer Chain', 'Main chain', 'Pending BS_Record', 'Pending Transactions', and 'PendingDolilLekhokInfo' as empty arrays and adds the genesis block with 'createNewBlock' with nonce, previous block hash and current block hash. The 'createNewBlock' function constructs new blocks using a given nonce, previous block hash, and current block data, resetting pending records and transactions before adding the block to the chain. Similarly, 'Create Deed Writer Block' creates new blocks for Deed Writer information and adds them to 'Deed Writer Chain'. For transactions and records, 'Create BS_Record' and 'Create New Transaction' create new BS records and transactions, adding them to pending arrays. The 'hashBlock' function hashes block data, while 'Proof of Work' iterates to find a valid nonce with a hash starting with '0000'. Retrieval functions include 'Get Block' to find a block by hash, 'Get Transaction' to find a transaction by ID, 'Get Khatian' to find a BS record by Khatian number, and 'Find Khatian in Chain; to search for all occurrences of a Khatian number in the chain. Deed Writer information management involves 'Add Deed Writer Info' and 'Add Pending Deed Writer Info' to add new entries to respective arrays, and 'Get Deed Writer Info' to retrieve Deed Writer chain data.

EXPERIMENTAL RESULT AND DISCUSSION:

Figure 8, shows the home site of our proposed system. There we can see all the blocks organized in order. It can be millions of blocks. For simplicity, we display only four blocks in this prototype, acknowledging that each block takes some time to create.

Here, the first block (Block 1) is called the Genesis Block. It does not contain any records. So, the Genesis Block hash is zero. Genesis Block also does not have any previous block so that the previous block hash is also zero.

As mention earlier, we have actually two Blockchain. Figure 8 shows the Main Chain of our proposed system. Every block contains 5 parameters or arrays. 'Nonce', 'Hash' and 'Previous Hash' are the identity parameter of a block. Then we have two more parameters that contain the land record information. These are the 'BS Records' and 'Transactions'. In the second block we can see that there is a BS Records array. Third block is as same as the second block. In the fourth or final block, a transaction occurs. So we have a new BS record that is created by the transaction and is recorded in 'BS Records' array. Also, the information regarding the transaction is recorded in the 'Transactions' array.

Every transaction has a unique transaction ID. So if anyone is interested to search by a transaction ID he/she can do it with the help of inquiry table. Figure 10 shows a result of searching transaction ID and Figure 9 shows the inquiry table. A user can search a particular khatian (11) or any details by choosing options. For the simplicity of the prototype, we use a few data in 'Transactions' and 'BS Records' array otherwise it takes a lot of time to mine a block. We need to test in every steps of our work so frequently. So, if we use all the data regarding a proper land transfer then it is very difficult to run the program with our average laptops.

Now in practical case, if a person need information of a particular land then he use the khatian option in the inquiry table, give the khatian number in the required place and press search option. By doing this, he/she has every details regarding of that khatian. An example is shown in Figure 11. There the first column shows the BS Records and the second column shows the transactions. Except the first row, every row has a transaction because those BS Records are created for those particular transactions. Here 'Sender' is the seller and 'Recipient' is the Buyer.

Figure 8: Home Site Interface.

Figure 9: Inquiry Interface

Figure10: Transaction ID Look Up
Interface

Figure11: Khatian Look Up Interface.

LIMITATIONS:

1. The major limitation of this proposed system is that if the witnesses are not part of our chain, then transaction is not possible.
2. Other major problem is we are not able to digitalize the Stamp Duty.
3. Another major one is what if the Sub-Registrar continuous to disapprove the request for some personal issue with that particular person. Every time Sub-Registrar need to show the cause of disapproval. If he continuously shows various cause and disapprove the transaction, then in that situation we don't have any solution.
4. In phase 2, if any mistakes occur in recording "BS Records," such as incorrect changes to the Khatian number or other information, we face challenges because the data has already been uploaded to the Blockchain, which is immutable. However, solutions do exist to address such issues. For example, a new corrected entry can be appended to the Blockchain, providing an auditable trail of corrections. This ensures that while the original incorrect data remains unaltered for transparency, the correct information is also recorded and easily accessible.

5. The digital payment system linked with our proposed Blockchain is not yet developed. If we can develop it in the future, some other manual procedures like Stamp Duty, Registration Fees, and other outstanding fees can be handled easily and digitally.
6. There are some major manual steps also.
7. Actually, in our proposed system, both manual and digital procedures goes together. Because we think we are not ready yet to totally digitalize the whole system. For that we need a bigger team with coding and error handling experts.
8. Privacy of land owner's land information is not maintained here etc.
9. Our Prototype does not contain much data because of the power required of mining. We use some sample data to run our test.

Table 2: Comparison Between Our Proposed System and Existing System.

Existing System	Proposed System	Comments
1. Initial Agreements - Identify Buyer and Seller - Verify Property Details - Obtain NOC	- Manually agreement - Identification and verification digitally (Authenticated)	- Existing System's Steps get reduced. - Verification of Buyer and Seller manually.
2. Preparation of legal documents - Draft Sale agreement - Sign Agreement	- No need to prepare legal documents. Complexity of documents is eradicated. - Manually draft and sign agreement.	- Verification of property information manually.
3. Payment of Stamp Duty - Calculate Stamp Duty - Purchase Stamp Duty - Affix Stamp Duty	- Stamp Duty totally manually	- Existing system's Step 1, 2 and 4 are combined together as a step. - Sub-Registrar office complexity reduced.
4. Execution of Sale Deed - Draft Sale Deed - Sign Sale Deed	- Already done	- The availability of information is so much faster and easier.
5. Registration of Sale Deed - Submit Documents - Visit Sub-Registrar Office - Verification by Sub-Registrar - Pay Registration Fees - Biometric Verification	- In Phase-3	- Existing system's step 5, 6, 7, 8 and 9 are combined together. - Proposed system has only 4 steps.
6. Post Registration Procedure - Obtain Registered Deed - Update Land Records	- No post registration Procedure.	- The system developed in this study is designed to closely align with existing systems, thereby minimizing the training required for governmental officials and individuals. This compatibility ensures a smoother transition and more efficient implementation.
7. Mutation of Property - Apply for Mutation - Submit Required Documents - Verification and Mutation Entry	- Mutation happens automatically in Phase-3.	
8. Obtain Mutation Certificate	- Get the Certificate immediately when mutation done in Phase-3.	
9. Final Compliance - Update Municipal Records - Pay Outstanding Dues.	- Automatically occurs in Phase-3.	

CONCLUSION

In conclusion, our proposed system follows every rule of the traditional land ownership transfer process but with minimum steps. The adoption of this system has the potential to significantly reduce the backlog of land-related cases in the judiciary, promoting a more streamlined and trustworthy land transfer ecosystem in Bangladesh. The transfer process is recorded and every transaction is immutable. So, every information is instantly available which will prevent most of the fraudulent activities. Besides, due to the similarity with the current process, this new system can be easily understood, and training for the new employees will also be very easy.

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