A secured land registration framework on Blockchain

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***Abstract*—Land is an immovable and non-liquid asset having high value. The integrity and proper track of ownership/transfer records of land is a highly challenging task. As the ownership of land can constantly change over time and that too sometimes very frequently, it poses a daunting task of keeping elaborate and long ownership transfer records. The problem further escalates due to presence of fraudulent or incomplete registries which are very difficult to trace back through time. Thus ownership disputes in the system, lead to litigation running for years, leading to wastage of valuable time, energy and resource for solving these disputes. Most of the issues root from the problem of the current land registration systems being either having legacy paper document trails or from poorly kept non-transparent centralized systems. Fraudulent users may try to forge paper documents or modify electronic records to change the land ownership record. This paper proposes a secure record keeping mechanism that addresses these issues using a Blockchain based system which can create record for the physical assets into an immutable liquid Blockchain based token asset. This new block chain token asset can now be used to keep a digitally secured and selectively visible record of ownership, solving the mentioned issues. An implementation of this system has been done using Ethereum and the benchmark data shows that the transaction processing time of such a system is reasonably low thereby making it suitable for practical implementation.**

***Index Terms*—Blockchain Land registration Liquid asset storage Asset as Token**

I. INTRODUCTION

Every nation has strict set of rules for transfer of land and property ownership among its citizen. Following the established set of rules is a mandatory criterion for the transaction of land and property. Depending on the type of property, whether single owned or multi-owned property, the transaction goes through different procedures. Moreover, any case of dispute among the residents for ownership of the properties is mostly handled by the law of the concerned nation. Despite having strong laws in various nation, the present scenario is inept to handle the various challenges like immutable records of property, handling fraudulent transaction etc. Moreover in many cases, sale documents deliberately does not mention about the ownership but only of the sales transaction, which is liable to be disputed. Verifying the ownership of such property always involves verification from official based on historical records and so lacks an independent variability. Experiments in some states to build register have not been successful as they suffer from problems arising from lack of updates, fragmentation of lands, informal family partitions, unregistered power of attorney transactions, and numerous boundary and ownership disputes. The opacity and uncertainty of the sale documents mitigate the chances of reliability on the transfer of ownership via the current procedure.

For proof of ownership, one needs to produce a warranty deed from the previous owner or a deed of ownership via inheritance or a quitclaim deed to claim ownership of the current owner only over certain parts of the property. Some states require a deed of trust while lending loans to individuals using a mortgage.The trustee holds the property deed until the property owner pays off the mortgage debt. Either way, a genuine document related to the same cannot be verified for any kind of discrepancy. Moreover, the production of forged documents or duplicate documents is viable to human ill effects.

While some states have all the information related to transfer of ownership in a centralized database, many states still persist in the traditional way of paperwork for the same. While the ill effects of paperwork rise from the loss of the deed to the creation of forged or duplicate papers related to any property or land. The database concept again proves to be another hub of discrepancy and conflicts as its management is done by some authoritative powers of a nation. Moreover, the transactions are not bound to be verified or collaboratively transacted as they are not accessible to the residents of the nation.

In such cases, the quality of transparency and certainty of the Blockchain[1] Technology comes handy for solving the archaic way of transferring land ownership [2] [3]. The

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decentralized approach tends to solve the issues related to the centralized approach along with the mitigation of the residents to be dependent on the higher authorities for a single transaction of property. In order to leverage the decentralized storage system provided by blockchain backbone the Ethereum[4] decentralized execution platform provides the safe virtual environment for executing logic over the data shared among multiple nodes.

The system proposed in the paper solves the problems of the existing system along with serving the intricate aspects of the land ownership transfer like hereditary, wills, and mortgage cases using decentralised application as a foundation. The approach of the system of consensus verification and access to the records along with the absence of any middle entity results in a conflict-free system.

The rest of the paper can be referenced as follows. Section II focuses on the various related works done with respect to the land registry system in both traditional and technical ways along with a critic insight into the features of the systems. The section also mentions a comprehensive study on the tools used in the implementation of the proposed system. Section III gives a fair idea about the architecture, flow of data and the model used to recount the system. Section IV evaluates the system and analyses the different aspects of the system in terms of space, cost of transaction and time complexity according to the recent measurement of gwei. It also describes the ways by which the system proves to combat the various adversarial attacks. Section V concludes the paper after dealing with the trade-offs of the Blockchain network on the system.

II. Background

A. Related Work

The land registration process in every nation is governed by the laws of the constitution. The general steps for the current system of land registration and ownership of various nations can be described as follows-

- The property/land documents need to be submitted to the appropriate authority within whose jurisdiction the property is located. For registration of the documents, the authorized signatures of seller and buyer need to be presented along with witnesses.
- A proof of payment of necessary fees and duty should also be presented to the sub-registrar along with the property card.
- The signatories should establish his/her proof of identity with the authorities for the land registration procedure.
- In case of a real estate company is part of the property agreement, the person representing the company needs to carry authorized, related registration documents like the letter of authority or power of attorney based on various rules of different nations.
- In case of any discrepancy, the authority has all the rights to reject the registration procedure and registration documents.

As the processes are cumbersome, many a time there are third parties involved in the process who performs some or most of the task on behalf of seller or buyer. The online land registration system of other nations have reduced some of the burdens by eliminating the need of any third party. People can pay the necessary fees online and initiate the transaction. However, in most of the cases verification of the required documents still needs the presence of the buyer and seller along with witnesses of each side to be produced in front of the official as per law.

Some nations, like Sweden[5], Netherlands, Honduras[6], India[7] and Dubai[8], have planned to shift the land registry system into a Blockchain based system. The Sweden project has some documentation related to their project. Taken up by the Chromaway[9] in the year 2016, the Sweden project is under the second stage of development. The architecture of the project can be diagrammatically described in Figure 1.

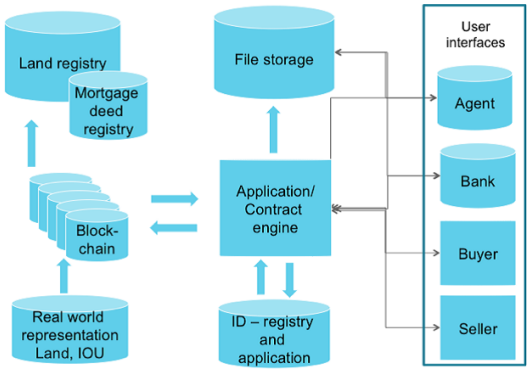

Fig. 1: The architecture of the Sweden Land registry project [1]

The technical demo that is currently being built as part of this project uses ChromaWay's technology and programming structure Esplix, which creates smart contracts/embedded contracts in a Blockchain. In practice, a chain of messages is saved into a private Blockchain, which can execute the transactions between the parties more quickly. When the contract is finished, it can be summarized into a hash that can be added to other Blockchains like Bitcoin's Blockchain as an extra back up. Everyone involved can also save all or part of the Blockchain, which covers the personal transactions in the system. Both buyers, sellers, banks and real estate agents can therefore verify the history of a transaction. An additional benefit of this procedure is that the solution is even easier to transfer to an alternative Blockchain. Let's assume that a few Government agencies jointly build a Blockchain that they control. The solution they have built in the test bed can be easily secured, even in this Blockchain. A solution with Colored Coins is somewhat more hazardous and difficult to transfer since the code is written on top of a specific cryptocurrency.

The Netherlands Land registry is willing to test the Blockchain technology for the real estate data along with Artificial Intelligence for cognitive systems to make predictable models. Other countries like Russia, the United Kingdom and Brazil have initiated their projects on the land registry system.

Dubai, on the other hand, has become the world's first government entity to adopt Blockchain technology for land ownership registration. Blockchain has been used as a secure database of records including lease registrations and linked them to the Dubai Electricity and Water Authority(DeWA), the telecommunications system and various property related billing systems. The method of IPFS for storing the Emirates Identity Cards and the validity of the visas of the residents and the provision of the tenants to pay the rents electronically via their interface has multiplied the positive impact of the system on the residents of the nation.

III. Proposed Scheme

We now propose a programmable block-chain or smart contract based implementation for land ownership and transfer of land ownership record in a decentralized fashion. This approach will enable us to handle all the aspects of the property ownership like the partition of land, hereditary cases and disputed land segments in an immutable and publicly-verifiable ledger system.

A. Assumption

There are a few assumptions that we have to take about the physical world and its interaction with our virtual record keeping system beforehand.

Mapping to a specific token format : The system build in this paper is mapping every land segment to a certain amount of token based on the ERC20 token. Any kind of different token system cannot be mapped with the system

No verification for inconsistency: The system does not ensure that the updating of the ownership details by the current owner of a piece of land is being done willingly or under compulsion of external matters. Since the records are public in nature, the authority and the respective citizen can cross check at any point in time.

Dependency on external financial transaction: The passing of the segments of the land, as distributed into tokens, shall not be verifying the actual transaction of the finance via any other medium.

Dependency on central citizenship database: The system depends on the citizenship record system of the nation for the transfer of ownership of land to the respective heirs after the death of a particular resident. The system is not responsible for any discrepancy in the entry of the names of the citizens.

Authenticity of the existing data on land ownership: The proposed system assumes that the data regarding the current ownership of land and property by the residents is authentic in the true nature.

B. Model

The proposed system, as compared to the single point failure architecture of centralized systems, has found a profound upper hand in terms of the safety and undisputed data storage in the form of Directed Acyclic Graphs in every node of the system. Falling prey to the uni-verification of the land ownership management by a single entity has resulted in several forms of fall-outs, which requires a dedicated source of time and financial support for the outcomes which also sometimes result to another class of disputation.

In contrast, the system, with its robust nature of storing and securing data, has achieved an enhancing form of scaling and authentication of entities of the system. The single consensus and dual consensus ensures the validity of every transaction of land and property ownership. Moreover, the time-stamp of contracts like testaments and mortgage deeds are also handled with a sense of executing only at the precise hours. Many other edge cases related to transfer of land and property is being handled with the assurance of a discrepancy free system.

The system strictly follows the decentralized aspects of a hybrid Blockchain with a consensus mechanism of entities for every transaction. The data on the system shall only be available for viewing by the members of the Blockchain. Members outside the visual range shall only be able to view the properties for sale but at the cost of being enrolled under the Blockchain thus ensuring no outer contact of the Blockchain data with the unauthorized people of the restricted areas. The permission system redefines the core concept of access control for reliable data storage.

The detailed model of the proposed system, as depicted by fig1, comprises of various entities interacting with the Decentralized Application. The application mainly consists of a "Genesis list" which initially contains the plot_IDs of all the acquired land pieces along with the plot_IDs of the land acquired by the highest authority of the state. The dual consensus of the new owner and old owner initiates the process of transactions of land between them without the entry or involvement of the third party like the current centralized system.

Although the addition of any resident would not require the consensus of any other entity of the Blockchain but the verification of the new member must be done by the citizenship record system of the state. The citizenship record system shall take the responsibility of ensuring the new member to be a resident of the country. Here, a token generation system is developed which authenticates the member against a data storage system such that it proves the citizenship of the member. Only after authenticated information, the proposed system allows the member to join the Blockchain to view the properties for sale. As every owner of land is already recorded in the Genesis list of the system, the existence of a current owner of land outside the system is demolished.

The whole system stands in correspondence with a decentralized back-end code which is responsible for the execution of all the methods of the smart contract of the initial system. The methods define each land piece against a plot_ID to be divided into one hundred million sub-tokens for the enhanced division of land into segments and transfer partially or completely, relaxing the distribution of weights of land among different members.

The system has three fundamental entities for smooth execution.

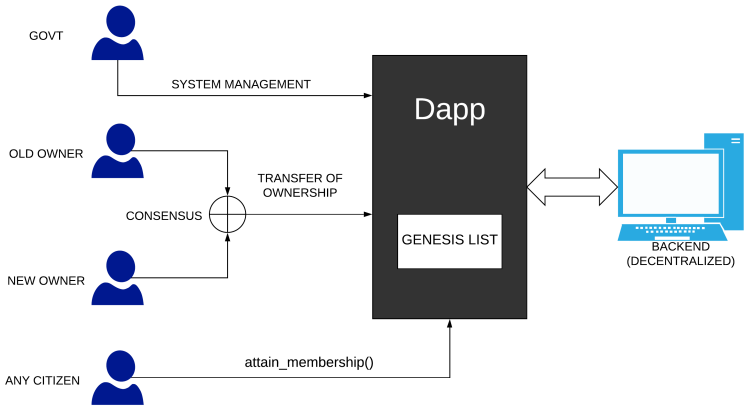

Fig. 2: Block overview of the proposed solution

Government Authority: This entity is given a special address which can never be transferred to any other resident of the state or any other member of the Blockchain. This entity shall initially start the system owning the genesis block. In the next stage, the plot_IDs are distributed among the respective owner addresses. Any kind of disputed land or physical land lost due to unavoidable natural circumstances shall be declared null and void by the government authority address. Thus, such tokens shall never be eligible for any further transfer of ownership. This authoritative address also has the power to terminate the working of the system by declaring all tokens to be null and void in case of emergency or unnatural dissolution.

Land Owner: Every plot_ID shall be mapped to an owner address who has the capability to divide the tokens into sub-tokens and transfer the ownership of the mapped tokens among other nodes in the Blockchain with the consensus of the new owner or a new member of the Blockchain. If the tokens mapped with the owner address are declared null and void, the tokens shall not be capable of subdividing or transfer, although the records of the initial owners shall remain valid.

Non-members of Blockchain: Any resident of the country, after being verified by the citizenship record keeping system of the respective nation, can join the Blockchain without any other type of consensus to be met. The node can only view the details of the properties on sale by the existing landowners. After acquiring ownership over a portion of the token, the address gets added to the genesis block and gets recognized as a current owner of tokens.

The above entities work simultaneously to maintain the integrity of the system. The ease of transferring land ownership without any kind of paperwork or legal processes take away the hassle of investment of time and money for futile reasons.

C. Architecture

Behind the decentralized interactive application, a decentralized code written in Solidity, a Turing complete language, is responsible for the deployment of the smart contract along with proper execution of the methods to be called by the decentralized applications. The functions altogether act to intertwine the functionality of the application along with input, output, and decisions of the prospects of the system. Below we list out the primary properties of the smart contract and their interactions.

1) Data Structure: : A Directed Acyclic Graph is used for the storage and duplication of data on every node of the Blockchain. The initial data structure is the Genesis block, which is executed as an ”event” due to its cheaper storage alternative, comprises of the mappings of plot_IDs against owner addresses along with the location and property acquiring details in the form of a tree. Any division of the land piece, taken as tokens, can be subdivided and the new plot_IDs are stored into the genesis block for further ownership transfer. The ancestral data about the line of ownership details of every token is stored against the plot_IDs of the group of tokens.

Government address: An already generated address is assigned as the government address for handling any case of emergency and discrepancy regarding land tokens. Initially, the genesis block is named into the mapping with the government addresses. This non-transferable address has the power to assign a null and void value to any token or to terminate the system under any natural or unnatural circumstance. This node is given utmost priority only in need of verification, else every other transaction does not need authoritative power.

Resident nodes: The randomly generated addresses for each land owner has a mapping to the plot_IDs of the tokens under the respective address. The data structure is defined by fields of current_owner_address, previous_owner_addresses, acquiring_date_time, and flags to interpret the status of the land. It shall also contain a trailing address of all the child plot_IDs and addresses

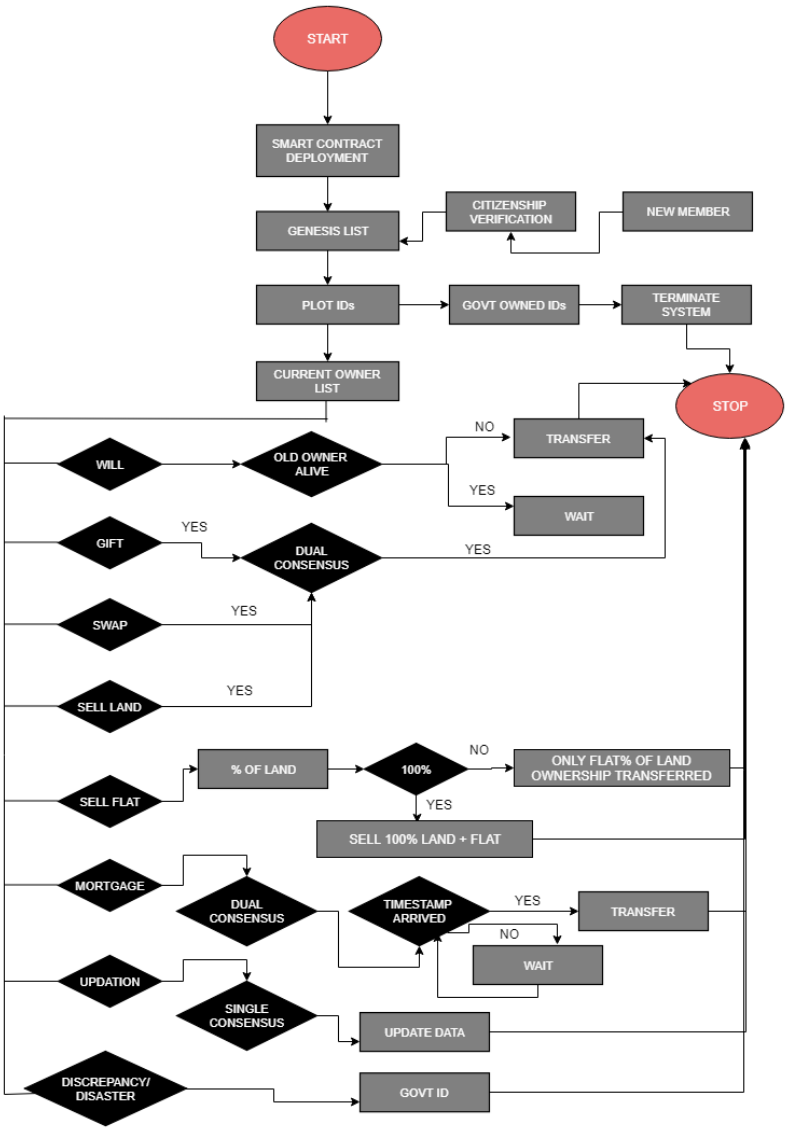

Fig. 3: Flow chart of the proposed system

of the old owners of the subdivisions of the tokens. The flag can be assigned a value of 0 or 1 for indicating the selling status of a certain percentage of tokens.

2) *Functionality:* :

Adding a node: Any node, on being verified by the citizenship record system of the particular nation, can join the Blockchain for viewing the properties on sale. This is especially with respect to safeguarding the access control of the intricate data of the land owners.

Division of tokens: Every transaction of ownership transfer of land goes through the consensus mechanism where both the participating entities verify the occurrence of each transaction. No transaction can be done without the consensus, thus minimizing an error-prone situation of land ownership transfer.

Transfer token: A token as a whole or in collaboration with other consecutive tokens can be transferred, i.e., the owner addresses with respect to the plot_IDs can be changed without any manual intervention. There is a restriction followed that the divided tokens cannot be in random numbers but in consecutive sequence in order to secure random sale of physical land area.

Dual Entity verification: Every transaction of ownership transfer of land goes through the consensus mechanism where both the participating entities verify the occurrence of each transaction. No transaction can be done without the consensus, thus minimizing an error prone situation of land ownership transfer.

Data Update: Updating of data related to any information on the nodes is not allowed inculcating the members

of the Blockchain to enter details of the transactions devoid of any error. The reason for such restriction is that tokens once transferred can only be returned by again transferring back the tokens to the old owner with the consensus of both the entities. This is to ensure that no discrepancy arises due to transaction delay or swift transactions trying to attack the system.

Creation of time-stamp testament or mortgage: Creation of wills and mortgage deeds which shall have to be executed only after conditions of time is met is a big factor touched in this system. The contract shall not be executed until the citizenship record of the nation verifies about the death of the land owner in case of will or testament. In case of mortgage deeds, the contract shall loop around for the correct time-stamp. If the mortgage deed needs to be canceled before the time-stamp of the contract, the flag in the contract ensures that the transfer of ownership does not occur without the consent of the existing owner.

D. Implementation details

The participating entities of the system can be defined using the following data structures.

Other structures include a mapping from address to string, newMemberList, which serves as a data collector for all the members who are verified by the citizenship record of the nation and who wants to join the proposed Blockchain system.

Struct *token* **contains**

```
string location // Location of piece of land
uint256 PlotID // Piece ID of the token
bool status // Selling status of the token
```

end

Struct *ownerInfo* **contains**

```
uint256 plotID // The piece ID of the acquired land
uint256 acquireDateTime // Date and time of acquiring the land
uint256 sellDateTime // The date and time of sale of piece of land
uint256 tokenSize // Number of tokens equivalent to the land area in acquisition
```

end

The genesis list is a mapping from address to piece of land as stated above to contain all the list of the land owners. The entry into genesis list is being served as an event.

event *genesisListEntry*(address oldOwner, address newOwner, uint256 token)

Where oldOwner is the address of the current owner node, newOwner is the address of the node of the buyer or new owner of the piece of land.

Events are dispatched signals which can be fired by the smart contracts. Any decentralized application connected to Ethereum JSON-RPC API can listen to these events and act accordingly. The main reason to use event here is that it can be indexed and the history can be searched in an efficient manner.

Algorithm 1: Adding to Genesis List

```
function dualConsensus (newOwner, oldOwner, timestamp);
if oldOwner & newOwner in record then
    if token[address].status == 1 then
        return 1;
    else
else
    returnfail;
end
function addToGenesisList (currAddress, newAddress, token);
if oldOwner & newOwner in record then
    if dualConsensus then
        append to genesisList(struct ownerInfo)
    end
else
    returnfail;
end
```

In algorithm 1, it is checked whether there is a consensus of both the entities for the transfer of land ownership from an existing land owner to another node in the Blockchain. Only on that respect, the new owner(s) of the land or tokens is/are appended into the Genesis list and if all the tokens acquired by the current owner is being sold, the address of the node is removed from the genesis list and appended to the newMemberList, which comprises of the nodes which are not owners of any token.

The algorithm 2 displays the various operations that can be done via the system for better functionality.

- Will: The person who wants to prepare a will has to execute this function with the consensus of a government ID to ensure dual consensus mechanism in the contract. The contract shall not be executed until the information about the death of the person is received from the citizenship record of the nation. Soon after the information retrieval, the ownership is transferred to the rightful heir. If the current owner wishes to pass the property to an unborn child, it can be done via the rightful mother of the child. Although the mother does not become the owner of the land, but soon after the information is received of the birth of the child from the citizenship record, the transfer of the land is done by the contract. If under any circumstance, the child is not born, the land gets transferred to the government address for it to resolve the issue.

- swapOrGift: If two nodes of the Blockchain wish to swap their ownership of properties or if a node wants to gift some tokens of the land to another existing node on the Blockchain, it can be done via the consensus of both the entities. Without the consent of one, the transfer of ownership cannot be done. Thus the details under the

structure of the owners are altered on the basis of the number of tokens transferred.

- Apartment: An apartment consists of many flats. Every owner of a flat has some tokens of the land under his/her name, which is indivisible. Thus, if an owner of a flat sells the flat, the tokens are also transferred without losing the indivisibility property. But no owner can individually claim the tokens for selling individually. If all the owners of the apartment agree to sell their flats to a single node in the Blockchain, it can be done after checking the status flags of the ownerInfo. The tokens then become divisible and transferable like any other land or property.

- Mortgage: Many times, people while taking loans or finance from some other entity, may keep their portion of tokens as collateral. In such circumstance, the lender needs to be existing in the Blockchain. The mortgage is signed by both the parties via the consensus mechanism along with a provision of timestamp after which the tokens shall be transferred to the lender, if repayment is not done. While the designated timestamp is not reached, the contract shall not be executed. During the time, if the repayment is done and both the lender and the borrower sign to cancel the contract, the contract stands canceled with an indefinite timestamp.

IV. Evaluation

A. Adversarial Model

In dual-consensus protocol, the actions outside the expected behavior of the node are considered malicious. A large amount of such malicious activity tends to break the fundamental assumptions of a protocol running the algorithm in the network. To create protocols with the right set of assumptions is critical to external intervention with authorization to reboot the system.

The system proposed is supported by the underlying security provided by a decentralised computational framework offered by something like Ethereum[4]. So any system adversary possessed[10] by the aforementioned will also be shown by the system proposed in this work if implemented with tight coupling. Problems related to double spending and illegal token sellouts [11] is not applicable here on account of the system not managing tokens in the traditional sense and token division is coupled with the existence and trigger of a digital Will which is part of the Smart contract.

A crash fault that makes nodes go offline permanently while in the process of transaction adversely affects any system. It cannot be expected that all the nodes remain permanently online and that the time taken for any transaction is fixed.

Passive adversary by nodes trying to eavesdrop transactions is being handled in the proposed system. The system does not allow any non-owner of land to check any information related to the land owners. The existing land owners also have a visual limit as all the details of all the owners are not visible to them. Only the addresses taking part in a particular transaction along with the transaction details are allowed to be accessed by them. The contract executed between the two land owners cannot be accessed by anyone but the nodes taking part.

Algorithm 2: Operations

```
function will (oldOwner, govtAddress, newOwner,
token[plotId], bool death)
if oldOwner & govtAddress in record then
    if dualConsensus then
        while (!death);
        addToGenesisList(newOwner);
    end
else
    returnfail;
end
function swapOrGift
(newOwner, oldOwner, token[plotId]);
if oldOwner & newOwner in record then
    if dualConsensus then
        addToGenesisList(newOwner);
    end
else
    returnfail;
end
function allApartment
(oldOwners[], newOwner, token[plotId]);
if oldOwners[] & newOwner in record then
    while n
    if oldOwners[n].status & oldOwners[n].plotID
     is same then
        addToGenesisList(newOwner);
    end
else
    returnfail;
end
function oneApartment
(oldOwner, newOwner, token[plotId]);
if oldOwners & newOwner in record then
    addToGenesisList(newOwner);
else
    returnfail;
end
function mortgage
(oldOwner, deedAddress, token[plotId],
bool timestamp)
if oldOwner & deedAddress in record then
    while (!timestamp);
    addToGenesisList(deedAddress);
else
    returnfail;
end
```

The Byzantine adversary [12] tending to send false and conflicting messages in the network leads to messages or transactions getting dropped, duplicated or altered. These

Operation	Transaction cost(gas)	Execution cost(gas)	Total Cost(gas)	Total cost(USD) with 3 gwei
Will	3323911	3231231	6555142	2.69416
Swap or Gift	3360245	3164512	6524757	2.68168
Apartment	3303652	3036545	6340197	2.60582
Mortgage	3512548	3115968	6628516	2.72431
System total				10.70597

TABLE I: A breakdown of the cost of transaction and execution with an average gas price of 3gwei and 1ether = 135.59 USD as of March 2019

Operation	Time (ms)
Will	72
Swap or Gift	64
Apartment	128
Mortgage	165
System total	429

TABLE II: Timing analysis of the network

transactions are delivered out of order by an unreliable node and the dishonest assisting nodes try to confuse the rest of the network with contradictory messages. This type of adversary is not likely to be possible in the proposed system as the amount of land, as assumed, remains constant. However, if the government agent in the system faces any kind of emergency, updates the system with the number of tokens lost or increased. Moreover, the inclusion of dual-consensus mitigates the probability of other nodes to interfere in any transaction.

B. Cost of transaction

In general, one of the core concepts of cryptocurrency, trustless verification, causes the most trouble for scaling. In all Blockchain protocols, each node stores all states with account balances, contract code, and entire transaction history, in order to verify a transaction's validity for each transaction in the Blockchain. This provides a large amount of security but limits scalability to not being able to process more transactions than any single node in the network can.

The implementation of the system was deployed in an Ethereum test network being auto-mined in the Ganache. The whole system is divided into two- one for the ERC20 token transaction and the other for the system transactions of land ownership. The system simulation was done for 30 nodes with a total of 36 transactions including the addition of new members into the nodes and ownership transfer transactions. Each transaction's computational cost(in gas cost) and financial cost(in US Dollar) is outlined in Table I.

The cost levied on per person in the network, if he wants to execute all the transactions, would be 0.36USD (rounded off to two decimals), which is 1886 times lesser than the cost required in the traditional system (An inclusion of 10% of the total cost of the land during the time of sale). However, the cost of each transaction on the actual Ethereum network would increase but will not be in comparison to the traditional system. The total cost in Table I is taking into consideration all the operations of the network is done by one node, which is the worst case. As maximum transactions are being executed on mappings, the addition, deletion and searching of entries would take a $\Omega(1)$, i.e., a constant time.

C. Timing Analysis

Table II outlines the time required per transaction for a network comprising of 30 nodes. All transactions were performed on HP laptop running OS Windows 10(Version 1803) equipped with 4 cores, 2.40GHz Intel Core i5, and 4GB RAM. Using the web3 framework, the interaction between the user interface and the Ethereum test network was done. The task was executed using the $.call()$ that allows calculation of the time required in every transaction on the network. All the measurements of time are being rounded off to the nearest upper whole number(in ms).

V. Conclusion

Traditional land ownership transfers constitute an investment of the prodigious amount of time and money. Many nations employ the presence of middlemen or nominees for a verified transfer of ownership, in spite of which, related concerns long to be raised. Moreover, many cases related to forgery and duplicate papers for one single piece of land can also be produced by a corrupt system. In order to address such challenges, the concept of Blockchain has been applied in the proposed system. The trade-offs have been looked at by designing, implementing and evaluating various cases that may arise in terms of ownership transfer of land. It was found that the smart contracts provide transparency and minimization of any third party entity involved in the designated process, thus reducing the amount of time and money laid out. The implementation has given acceptable transaction rate and transaction cost on the Ethereum platform. However, as the eth cost alters at a very high rate, there is always uncertainty about the amount of gas cost that would be required for each transaction. But regardless the system succeeds in tackling the problem mentioned. Thus, this Blockchain based system proves to be apt for handling all the cases of land ownership transfer at the cost of the participating entities of each transaction in the network.

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