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Smart Contract for Real Estate Using Blockchain

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Abstract : *The commercial real estate (CRE) industry appears to take pride in keeping several aspects of its operations private, such as comparable lease rental rates, property prices, and valuations, to create a possible competitive advantage. However, secrets are hard to keep and may not even be desired in today's hyperconnected and digitized world. In response to greater demand for transparency, technology advancements and the disintermediation by startups are gradually making some of this information public. As a result, property-related information is increasingly available in digital and paper form. However, a significant portion of the digitized information is hosted on disparate systems, which results in a lack of transparency and efficiency, and a higher incidence of inaccuracies that creates a greater potential for fraudulence.[1] This paper aims to present the Blockchain and smart contract for a specific domain which is real estate. Currently, the real estate business online is at risk of fraudulence. The main objective of this project is to create a platform to maintain transparency in the real estate world so that no fraudulent activities can happen due to false contracts. Goal is to create tamper proof systems and to remove third party reliability for transactions. Consensus algorithms such as Proof of Work and Proof of Authority can be used to achieve consensus in the network. Blockchain uses Proof of work concept to ensure transaction denial thus helping remove denial of services. Proof of authority on the other hand ensures only authorized smart contracts pass the system.*

Keywords*: Real Estate, Smart Contract, Ethereum, Blockchain.*

1. INTRODUCTION

Globally, real estate is undergoing a major evolution and transformation towards smart cities. Smart cities are being developed and a plethora of network, services, and transactions are integrated into the city planning initially and daily use.[2] Technology has not only improved the life of tenants but has also helped simplify the process of trading of properties. But, even technological advancements come with security threats. So, with evolution in Blockchain after cryptocurrency, the immutable, tamper proof technology started laying its roots in a wide range of applications. Real estate being unpredictable previously due to secrecies in lease agreements and other reasons can now be a transparent process with the help of Blockchain technology.

A. Blockchain

A blockchain is a time-stamped series of immutable records of data that is managed by a cluster of computers and not owned by any single entity. Each of these blocks of data (i.e. block) are secured and

bound to each other using cryptographic principles (i.e. chain). It is a decentralised, distributed networking system of replicated state machines that resemble the form of a data chain, where later data blocks refer to a single ancestor block often identified by its hash. When blockchain grows, new blocks are included in state machines and being propagated to all participating nodes within the network such that every node in the network has a single global view of all transactions.[3]

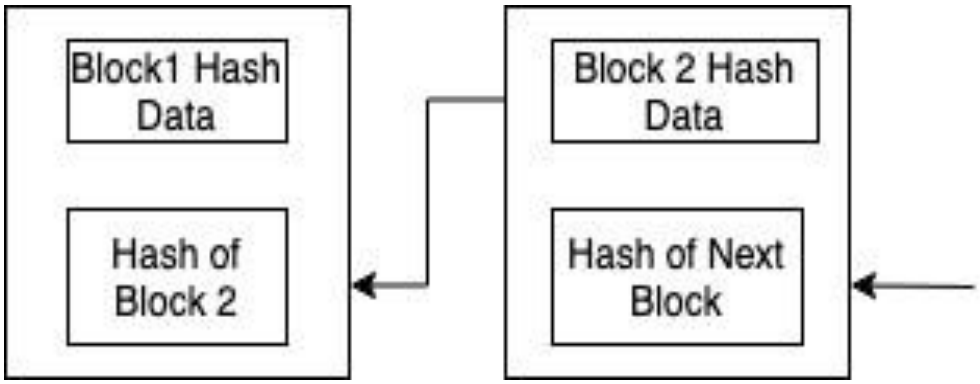

Fig.1. Blockchain Structure

B. Smart Contract

A smart contract is a computer program having selfverifying, self-executing, tamper-resistant properties. It is a piece of a program executed in a blockchain system that uses consensus protocol to run a sequence of events. A smart contract can be used in different fields to eliminate the third party transaction as well as automate the system. Consensus decisionmaking is a group decision-making process in which group members develop, and agree to support a decision in the best interest of the whole. The objectives of a consensus mechanism are Agreement Seeking, Collaborative, Cooperative, Egalitarian, Inclusive and Participatory.

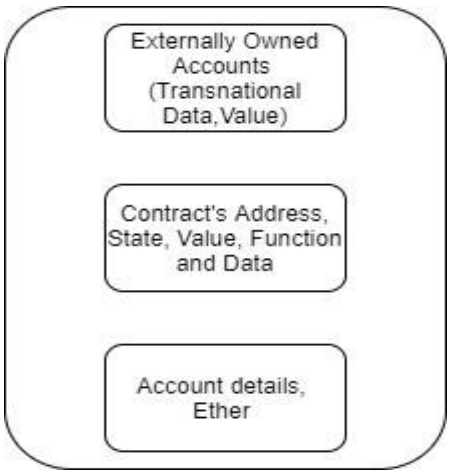

Fig.2. Structure of Smart Contract

C. Ethereum

Ethereum is a platform used for creating a decentralized network of nodes with transparent transactions using ether as cryptocurrency for transactions.It includes two types of accounts: Externally Owned accounts (EOA), users directly send transactions via them, and Contract Accounts, based on the codes of the contract if it needs to call another contract it sends an internal transaction.

D. Algorithm

Proof of Authority: Smart contracts require application from legitimate users and legitimate contracts in the block. To fulfill the above conditions, the concept of proof of authority comes into the picture. It basically validates at numerous levels.

Proof of Work: It is a protocol that has the main goal of deterring cyber-attacks such as a distributed denial-of-service attack (DDoS) which has the purpose of exhausting the resources of a computer system by sending multiple fake requests. Proof of work is a requirement of expensive computer transactions called mining which has the purpose of verifying the legitimacy of a transaction, or avoiding the so-called double-spending creating new digital currencies by rewarding miners for performing the previous task.

E. Framework

Truffle: It is a development environment, testing framework and asset pipeline for Ethereum. It has built-in smart contract compilation, linking, deployment and binary management. Network management for deploying to many public & private networks.

F. Ethereum Network Provider

Ganache: It is a personal blockchain for Ethereum development. It is used to deploy contracts,develop applications, and run tests. It is available as both a desktop application as well as a command-line tool (formerly known as the TestRPC). Ganache is available for Windows, Mac, and Linux.

3. IMPLEMENTATION

Currently, due to digitalization, even real estate business has switched to online. But the participation of 3rd party vendors for transactions and the brokers still exist. Even if it was somehow able to remove the brokerage, the system did not replace much human work, just made it digitalised. The tedious work of contract file verification still is done manually and the existing systems still are susceptible to frauds. The proposed system can be a better solution to the above mentioned problems by removing third-party's dependency, the brokerage and making the system highly secure and fraud tolerant by introduction of smart contracts. A web based application using blockchain-smart contract in Ethereum for property trades is being developed with objectives to remove third party reliability, ensure authorization, prevent fraud and denial of transaction for the Real Estate World.

4. METHODOLOGY

The website for Property trading using blockchain on Ethereum has three roles namely, the buyer, the seller and the validators.. The User creates an account(block) in blockchain for uploading Property Details. The user needs to buy ether for transactions. A smart contract consists of a contract and ether together in ethereum. When a transaction is being initiated, a block is created for both parties. For verification of smart contracts, Proof of Authority concept is used. For validation of transactions, Proof of Work concept is used. When another party is involved in the transaction with the first block, their chain is formed and both have. Solidity language is used to code for blockchain in ethereum. We use the above two concepts and form a chain of blocks as the users get added to the block, the chain increases and the chain of each user has the same blocks. In a decentralized system, consensus algorithms thus take care of multiple block changes at a time and update the network based on various factors.

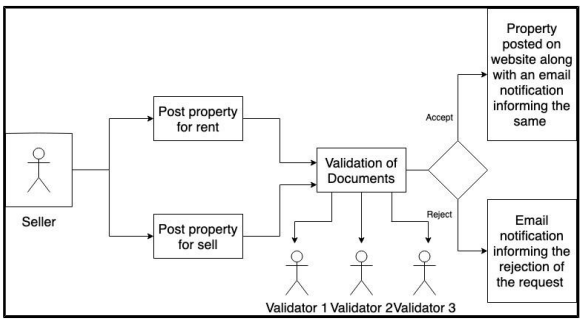

Fig.3. Seller side Deployment

If the user is a seller then the seller will have two choices.The first choice is to post property for sale and the second choice is to put property on rent. Depending upon the choice the seller has to upload the required documents. The seller will get a modal saying that your documents are under validation.The validators will then validate the document and if the majority of validators accept the documents then the property will be posted on the website and an email will be sent informing the same.

If the documents are not accepted by the majority of the validators then an email notification will be sent to the seller informing that the property cannot be posted as the documents have not been accepted.

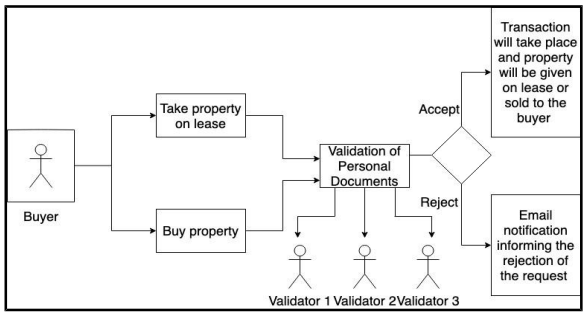

Fig.4.Buyer Side Deployment

If the user is a buyer then the buyer will have two choices.The first choice is to take property on lease and the second choice is to buy the property.Depending upon the choice the buyer will have to upload the necessary documents and then the documents will be validated. If the majority of validators accept the documents then the transaction will take place and the property will be given on lease or sold to the buyer and an email will be sent to the buyer informing the same.

If the documents are not accepted by the majority of the validators then an email notification will be sent to the seller informing that the property cannot be posted as the documents have not been accepted.

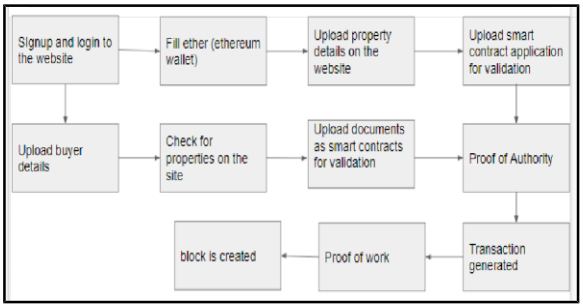

Fig.5.Workflow

A user can be a buyer or a seller. The buyer after signing up as seen in fig 5 goes through the process of uploading his/her details along with UID. After that, the buyer checks through various properties based on their choice of parameters. Once the buyer finalises the property they are interested in, they upload their documents as smart contracts for verification.

A seller on the other hand, fills his ether wallet and then uploads property details on the website. Once the details are put, necessary documents as smart contracts are uploaded for verification. These documents/contracts uploaded by a buyer/seller are validated using an algorithm called Proof of Authority. Using Proof of authority, authorised people are elected in the network with consensus of 51% or more control. These groups of people authorise other nodes in the block. After authorization, transactions are initiated. These transactions generated are again verified using Proof of Work consensus. In Proof of Work, validity of a transaction is verified. Thus, a block is created. Truffle, a framework of Blockchain is used to deploy smart contracts for the following project. It is linked to Ganache, a platform that provides 100 free accounts on ethereum blockchain network. Ganache is preferable due to the amount of free ether provided per account which is 100Eth per account. A network of 10 default accounts is created and can be viewed in metamask which is ethereum wallet. Metamask has a chrome extension, hence easily accessible from chrome.

5. RELATED WORK

Various Consensus Algorithms are used generally to elect leaders/groups of leaders that will decide the content of the next block in a network. The leaders are responsible for broadcasting a new block in the

network and the other peers can validate the content. Proof of Work, Proof of Stake, Delegated Proof of Stake and Proof of Authority are various algorithms. In POW, for an actor in a chain to be a leader, they shall have to find a solution to a particular math problem. Such actors are called miners and miners are rewarded with ether for mining and also for not cheating. High computational power makes attacking too expensive. Here, we are using POW for validating transactions. Proof of Authority, on the other hand, looks after rights associated to nodes by an authorized person. This person has the right to generate new blocks. Here, generally 51% of the nodes must vote to give a particular node an authority to assign and create nodes. The project is being built using Truffle suite framework as it has all necessary tools from deployment to testing the network. Web3.js is used for communication between user interface and solidity(smart contract code) as truffle provides packages for solidity programming language.

6. EXPECTED RESULTS

Since contracts on a blockchain are executed by a computer program rather than a human, parties can enjoy nearly instantaneous payouts and transfers contingent the conditions of the contract are being met. Updates in agreements or actions taken will be automatically updated in the blockchain record at real time. Immutability, greater accuracy and higher security is expected. Most legal contracts include numbers. Any time a bank officer, legal clerk, or broker updates those numbers, the opportunity for error is introduced. Computers rarely make such errors, making smart contracts relatively immune from some of the risks common to standard contracts. Reduced cost and elimination or reduction of "trust intermediaries," which can streamline the execution process is the most wanted outcome from blockchain technologies. A web based software with the above mentioned features as better than existing solution for online real estate trade is expected.

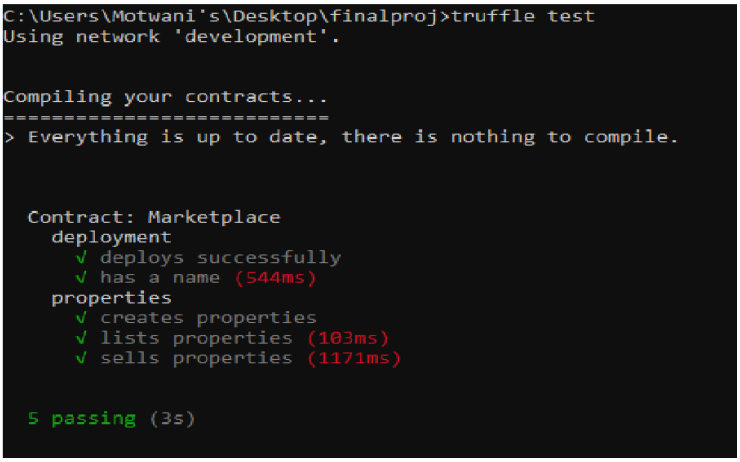

Fig 6.1 Contract test cases of functions and events generated

The above fig 6.1 is a snippet which shows the compilation, migration and deployment of the smart contract, processes and stores the function results in the contract. The functions that are executed and

passed the test via testpage.js file are named ‘deploy, has a name, createProperty, listProperty and sellProperty. On successful execution of functions, events are generated. These events generated displayed the message ‘deploys successfully’, ‘has a name’, ‘creates properties’, ‘lists properties’ and ‘sells properties’ is displayed.

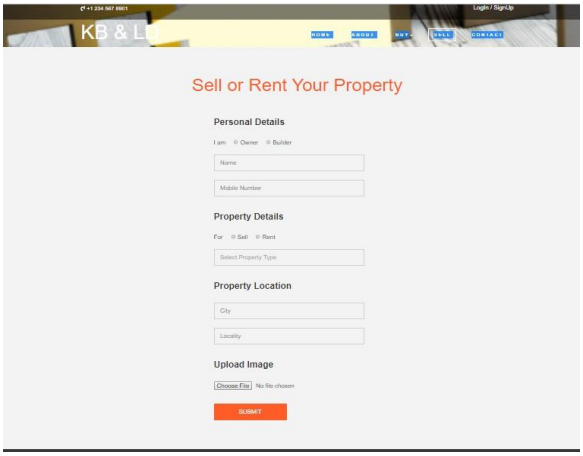

Fig 6.2 : Seller Details for adding properties

The above fig 6.2 is a snippet of a page which takes in the details of the seller who wants to sell the property. Various parameters such as personal details, property details, property location and property image have been taken through the form.

Fig 6.3 : Home page for trading Real Estate

The above fig 6.3 is the snippet of the home page of our web application. This website has a navigation bar connected to the pages with buying and selling properties, about page briefing about our site and contact details. Home page also has descriptions about the services provided and the featured projects at various locations.

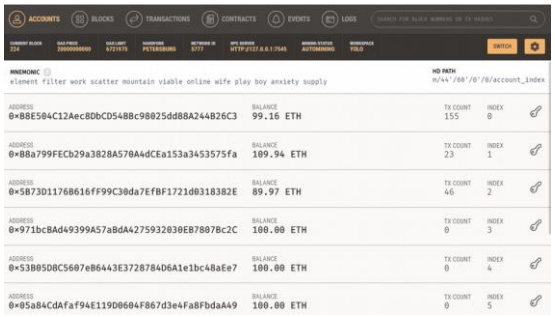

Fig.6.4:Ganache

Here in fig. 6.4, on our network, the first three accounts have been assigned to the deployer, the seller and the buyer respectively. The amount of 1ether is being transferred from seller to buyer on purchasing of property.

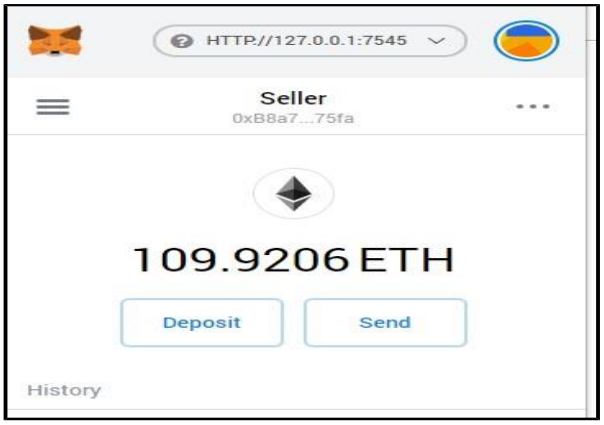

Fig.6.5:Metamask

In fig 6.5, metamask is displaying the seller's account balance on the network with address 107.0.0.1:7545 a private network address from ganache.

8. CONCLUSION & FUTURE SCOPE

Faster execution, reduced risks and highly secure transactions due to hashed blocks have made blockchain a strong technology. Immutability of blocks, proof of work and proof of authority make them fraud resistant. Proof of work helps remove denial of transactions. Proof of Authority for authorized documents and their validation. Denial of service attack will not exist with implementation of blockchain. According to the economic times, a large number of scams are being experienced in this digital era of real estate trade. Some of them include hackers stealing your down payment i.e. also known as the id theft, the bait and switch scheme where in buyer is made to pay above market value price, duplicate listings i.e. copying a legitimate rental listing and post on Craigslist for a much cheaper price, fake profiles, fake or no realtor license, fake escrow service i.e. asking buyer to pay before seeing an apartment, etc. India's demonetisation of November 2016 has become a major trigger for the country to move towards digitization and become a cash-free country. Though in their nascent stages, newer

and potentially disruptive innovations such as Cryptocurrencies and Blockchain have the potential to replace paper money with digital currency providing a decentralized and secured environment. Blockchain features such as distributed computing, confidentiality, authenticity, non-repudiation, data integrity, and data availability can help a populous country like India to turn into a cash-free economy. Blockchain makes a tremendous impact on the financial sector, particularly in speeding up and simplifying cross-border payments, in share trading, by way of smart contracts, improving online identity management and in loyalty and rewards (Deloitte; 2018). Evolution of Cryptocurrency is thus disrupting the electronic money sector.

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