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ORIGINAL

A trustable real estate transaction based on public blockchain: a smart contract-driven framework

Una transacción inmobiliaria confiable basada en blockchain pública: un marco impulsado por contratos inteligentes

R.Akila[1], J. Brindha Merin[1], Subhashini[1], Niyati Behera[1], Febin Varghese[1], Jeswanth.V[1]

[1]Computer Science and Engineering, B.S. Abdur Rahman Crescent Institute of Science and Technology. Tamilnadu, India.

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ABSTRACT

Introduction: the authorities responsible for Land Registration (LR) are often held accountable for the mishandling and forgery of LR documents in many countries. Some individuals may use a cutting-edge technology called Blockchain (BC) to digitally transfer assets such as currency, paperwork, and real estate (RE). Each transaction, monetary exchange, and shared information facilitated by a Peer-to-peer network (P2P) can be carried out through a designated node.
Methods: this paper proposes a method for secure transfer of land ownership using BC Technology without the involvement of intermediaries. Buyers and sellers are entering into a land ownership agreement via the Ethereum network. The decentralised systems has been to enhance their reliability. Currently, there is a growing development of decentralised solutions based on blockchain technology to tackle the limitations of centralised systems.
Results: the application of BC technology gradually mitigates the security concerns of the LR system. Due to the fact that each block is connected to the hash of the preceding one, each hash value will be unique. The SHA algorithm is employed for this purpose.
Conclusion: the ownership of the property cannot be transferred to the customer through the application. However, the smart contracts allow for automated updating of records.

Keywords: Land Registration (LR); Block Chain Technology(BCT); Peer-to-Peer Network (P2P); Cutting-Edge Technology (CET); Real Estate (RE); Smart Contracts (SC).

RESUMEN

Introducción: las autoridades responsables del Registro de la Propiedad (LR) a menudo son responsabilizadas por el mal manejo y la falsificación de documentos de LR en muchos países. Algunas personas pueden utilizar una tecnología de vanguardia llamada Blockchain (BC) para transferir digitalmente activos como moneda, trámites y bienes raíces (RE). Cada transacción, intercambio monetario e información compartida facilitada por una red Peer-to-peer (P2P) se puede realizar a través de un nodo designado.
Métodos: este artículo propone un método para la transferencia segura de la propiedad de la tierra utilizando tecnología BC sin la participación de intermediarios. Los compradores y vendedores están celebrando un acuerdo de propiedad de la tierra a través de la red Ethereum. Los sistemas descentralizados han sido para mejorar su confiabilidad. Actualmente, existe un creciente desarrollo de soluciones descentralizadas basadas en la tecnología blockchain para abordar las limitaciones de los sistemas centralizados.

Resultados: la aplicación de la tecnología BC mitiga gradualmente los problemas de seguridad del sistema LR. Debido a que cada bloque está conectado al hash del anterior, cada valor hash será único. Para ello se utiliza el algoritmo SHA.
Conclusión: la propiedad de la propiedad no se puede transferir al cliente a través de la aplicación. Sin embargo, los contratos inteligentes permiten la actualización automática de registros.

Palabras clave: Registro de Tierras; Tecnología Block Chain; Red Peer-to-Peer (P2P); Tecnología de Punta (CET); Bienes Raíces (RE); Contratos Inteligentes (SC).

INTRODUCTION

Overview

Since transparent financial management and transactions allow for the registration of land, the Department of Revenue & Land Reforms' RoR is judiciously analyzing the advantages of BCT. The LR utilizes BC to securely transfer assets. If ownership is not given to the buyer via an application form, the theory of SCs allows automated record update. The ownership of property may be determined with certainty due to BCT and SCs. Due to the agreement's automated implementation and imposition, this type of technology has increased trust among stakeholders to transactions. It also expedites and organizes corporate transactions.

The Department of Revenue & Land Reforms' RoR is carefully examining the benefits of BCT since public accounting and transactions enable LR. It transfers assets safely via BC. In the event that ownership is not transferred to the buyer through an application form, SCs theory permits automated record updating. According to BCT and SCs, ownership of RE may be established with assurance. This kind of technology has raised client confidence in transactions because of the agreement's automated execution and application. Additionally, it streamlines and arranges business transactions.

The fundamental and most significant feature of BCT is that it functions as a decentralized network. Any information supplied by a single node is validated by all other nodes that have been made accessible, and shared information is limited to uploading to the BC once a consensus has been reached.

BC-LR and administration technologies which are dependable, clear, permanent, as well as safe are being created by utilizing a variety of technologies. Among these technologies, SCs developed on the ETH (Ethereum) BC are becoming more popular. Anyone may enter the BC system because it is a PBC platform. BC is a dispersed, FT (Fault-Tolerance) database that allows any member of the network to share information without any central authority. Each block, with the exception of the initial block, known as the Genesisblock, is arranged as an append-only list and includes a hash value of the block preceding it.

Data transfer and asset functionality are encoded in every single block. Based on the verification outcome, each block is either rejected or broadcast into the network to be included in the current chain via special nodes. As an unchangeable record of transactions for the cryptocurrency known as Bitcoin, the theory of BC has gained popularity. BC has developed from digital money having the capability of programming, dynamic platform for creating dependable, dispersed apps. Data source, information robustness, decentralized consensus, and data consistency (integrity) are some of the essential features driving BC in the future. A distributed database operated on P2P network is the essence of the BCT, that drives contemporary cryptocurrency platforms as Bitcoin.

The BC is updated synchronistically by every peer in the network, and also retain an identical copy of it. The building blocks of BC are a series of transaction that save the information about the transfer (such as sender, recipients, and money) in a series of blocks. All of these blocks stores the preceding block's cryptographic hash, which links them collectively. A procedure known as mining creates a block's hash, and it takes a lot of computations. In the event that an attacker is successful in manipulating the transactions within a particular block, they will need to re-evaluate the hash values for both that block and any subsequent blocks. BC is resistant to tamp since this is generally regarded as being impossible.

Any nation's LR procedure tends to involve many steps, because it involves an involvement of all parties with a direct or indirect stake in the registration, including the buyer, seller, additional government departments and organizations, and citizens looking to find assets data. Major concerns about information deception, the privacy of highly sensitive information, and the possibility of system failure caused by catastrophic events, including a server that holds data storage falling down, it is raised by the present LR ownership data storage system. BCT and databases are CET and it may completely solve the issues in the existing processes when compared to present methods and procedures.

BCT is a decentralized system that ensures all information offered by a single node is verified by all other nodes that have access to it. Information shared can only be stored to the BC once a consensus has been reached. This is the fundamental and most significant feature of BCT.

BC-LR and administration systems are trustworthy, clear, permanent, and safe. These are built across a variety of technologies. For such technologies, SCs built on the ETH BC and have become more popular. Anybody is able to enter the BC system since it is a PBC technologies.

Blockchain is a distributed fault-tolerant database where each network participant can share but no entity can control this. It is organized as an append-only list where every block contains the hash of the previous block except the first block called the Genesis block. Each of the blocken codes some functionality such as assets and data transfer. Every block is broad castto then et work verified and added to the existing chain by special nodes or discarded according to the verification result. The concept of blockchain was popularized with the introduction of Bitcoin as an immutable ledger of transactions for a cryptocurrency called Bitcoin. Since then, Block chain has evolved from a digital currency to a programmable interactive environment for building distributed reliable applications. Some key characteristics which are driving blockchain forward are data immutability (integrity) data provenance data persistence and distributed consensus.

The blockchain technology the core of modern cryptocurrency systems like the Bitcoin is essentially a distributed database managed over a Peer-to-Peer (PP) network. All peers in the network maintain the same copy of the blockchain and synchronize to update the blockchain. A blockchain consists of a sequence of blocks each contains a collection of transactions recording the remittance information (e.g. sender receiver and amount). These blocks are chained together by each storing the cryptographic hash of its previous block. The hash of a block is generated by a process called mining which requires a huge number of calculations. Suppose an attacker manages to tamper with the transactions in a certain block he has to re-calculate the hash values of this block and also its subsequent blocks. This is considered impossible in general and thus makes blockchain a tamper-resistant database.

Although originally developed as a distributed database blockchain has currently advanced to a distributed computing platform thanks to the emergence of a new functionality called smart contract. The most representative realization of such novel blockchain is the Ethereum. An Ethereum smart contract is an executable program which like transactions is also stored(indirectly) on the blockchain. A smart contract consists of variables as its states and functions called Application Binary Interfaces (ABIs)to view and change the states. To execute a smart contract a transaction needs to be fired and broadcast to the PP network. All peers receiving this transaction will execute the smart contract to ensure the validity of execution results. Thus, by implementing the smart contract functionality the blockchain technology can further achieve distributed and tamper-resistant computing.

Blockchain is a particular type of distributed ledger technology. The data is recorded on the blockchain as a group of transactions called blocks. Each block has a hash value, and it links to the previous block by referencing the hash value of the previous block in the header of the current block. Consequently, data manipulation is not possible in the blockchain as even a slight change leads to an inconsistency between linked blocks and can be recognized easily. In order to attach a valid block to the blockchain a consensus mechanism is ap- plied. There are several consensus mechanisms with a trade-off between performance and security. Before the development of smart contracts blockchain applications were limited to creating cryptocurrencies and simple monetary transactions. The development of smart contracts has provided the infrastructure for creating more diverse blockchain-based applications. Smart contracts are executable logic encoded in blockchain with the ability to enforce automatically. Blockchain networks can be divided into two main categories: public and permissioned.

Public blockchains are open to the world and every user can join the blockchain with an anonymous identity submit a transaction and participate in consensus. Permissioned blockchains include an additional membership layer so only authenticated users can join the blockchain and interact with different components.

Blockchain is a database of gatherings exchanges that are connected to the past gathering of exchanges and is recreated and dispersed in the systems all copies so the blocks are distributed to everybody who takes an interest in database and are indistinguishable. Some blockchains (eg. open blockchains) work as decentralized frameworks. Members in the system over see and concur by agreement to the records. A problem was identified in this survey that classical land registration method is outdated and complicated. It takes a lot of time and efforts if you want to change any information on papers or to transfer registry to another owner. This motivates us to implement this project.

The implementation of blockchain technology for land registration aims to address the issues and shortfalls of the traditional and registration procedure. The current system is considered outdated and complicated, requiring significant time and effort for any changes or transfers of land registry information. For resolving these problems, blockchain-based solutions are strongly encouraged to be implemented in the land registration sector.

Applying BCT for creating more efficient and trustable LRS, and it is considered to be the main objective of this study. Then, the decentralized and replicated BC's set of linked transactions or "blocks". Thus, decentralized and replicated over network was done by these blocks.Every member in this block possess a unique copy of every block. As, these blocks are dispersed, there is no need for centralized management.

BCT can be employed for the purpose of developing secure as well as permanent LR transactions in the LR setting. And adding novel Blocks to the BC for the secure maintenance of transfer of every transactions or

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ownerships. The LR's reliability and validity can be ensured, as the data may not be altered once it has been recorded. Only network participants have the ability to the decentralized DM (Decision Making) as well as managing records. The participation of various parties in the transactional verification and validation is ensured by the utilization of census technique. It gradually decreases the dependability of centralized authorities, thereby increasing the system's public trust.

Eliminating the demands for the requirement of immense amount of records, simplify the procedure as well as lessening the paper work can be done through the application of BCT in LR. All involved parties can save time and efforts due to the effective means of transmitting assests or altering data in a secure, transparency and reliable manner. Improved DM and transparency in LRS can be achieved through the application of BCT in the LR information. Implementation of BC's LR strives for the completely transforming the existing system in adopting transparency and decentralized technology.

By doing this, the goal is to get around the drawbacks of the traditional land registration method, streamline procedures, and offer a more effective and reliable framework for managing land transactions and ownership

The phrase "LR records" can be defined as the official documents maintained and managed by government organizations that provide all pertinent information about any item of assets, including the present legal ownership of the asset or property. Obtaining knowledge regarding the land's previous owners and their historical ownership record is beneficial. Right of ownership are transferred from one hand to the other. The data kept in the legally binding documents is always subject to manipulation The initial RE transaction utilizing BCT took place as part of the property industry's modernization initiatives. A decentralized property app that supports BC-RE transactions was used to make the deal.

Some of these new businesses offer LR and asset administration platforms in addition to BC-RE transactions. This study suggests a decentralized hybrid BC framework that uses multiple consensus methods to validate land transactions among new and old owners without using third parties. Utilizing decentralized BCT, the framework also manages a variety of land ownership transfer instances, such as wills, mortgages, and the division of land in hereditary cases. This system is effective for applications in real time because it utilizes Ethereum, leading to very quick transaction processing times.

Several data structures, including arrays of data, contracts modifiers, functions constructors, and incidents created in SCs for web applications, are utilized while constructing various kinds of SCs, such as buyer-seller land inspector and incidents. The computer language Solidity is used to create smart contracts. The ABI file is used to access the SC functionality, and it is generated by the Solidity compiler.

Literature survey

Miroslav Stefanović et al.[1] conveys that Land administration is an essential part of any country's infrastructure, as it is responsible for the registration, management, and transfer of land ownership. Traditionally, land administration systems have relied on paper-based records, which can be slow, prone to errors, and difficult to manage.

With the utilization of BCT, the application of a safe and transparency SC for the purpose of managing LR is performed. SC is a coded contract and it is stored in BC. When certain standards are met, it aims to execute all terms of contract.

In the LR framework, the SC can be employed for managing the transaction of RE ownership, payment of RE taxes and other important land ownership processes.

The main reason for utilizing SC in the LR as it offers improved reliability and transparency. Dcentralized record of transactions exists in BC that is distributed across several nodes, and it records every transaction. It is extremely difficult to change or alter the records as it maintains highlevel of transparency and reliability. LR's another benefits are the SC's enhanced efficiency. The traditional LR techniques may be difficult, and ineffective, as it involves extensive authorization processes and managing individual's data. Eliminating the demanding of labour involvement, reducing processing times, the application of SC supports in performing transactions automatically.

It also reduces the expenses related to LR. Progressive decrease in the transaction cost can be achieved through the less demand of middlemen like legal professionals and notaries. Through automated transaction processing, the demand of administrative workers was eliminated, thereby reducing further expenses.

The utilization can also be made to connect with LR systems for facilitating easy transaction to novel system.

Adopting SC for LR has one difficulties as it demands standardization. Significant regional variations may arise in LRS. Thus, it is crucial in creating the worldwide standardized framework. But, it is feasible for developing a standard framework, as all nations may utilize with the appropriate policy and cooperation among stakeholders.

If SC is adopted for LRS transactions, managing RE may undergo major shifts. substantial advantages for governments, enterprises, and individuals can be obtained by the improved transparency, efficiency, and security via the application. Establishing and executing such framework is not easy, it may have long-term impact on the LRS across the globe, because the benefits are substantial.

The application of digital assets using BC and smart contracts was presented by H. R. Hasan et al.[2] a method of ensuring that digital assets are successfully transferred to their intended recipients. This method uses the features of BCT, like consistency and evident, along with SCs, that are self-executing contracts by the agreement between buyer and seller is directly transcribed in to lines of code, to create as ecure and tamper-proof system for verifying the delivery of digital assets.

Digital assets, such as cryptocurrencies or digital art, are in tangible and exist only in digital form. Therefore, it is essential to have a secure and reliable method for transferring these assets from one party to another. The traditional method of delivery of digital assets involves sending them via email or file transfer, which is prone to errors and can be easily tampered with.

SC and BC are employed for addressing those issues with POD (Proof of Delivery).Bc is capable in offering decentralized, transparent and constantly maintaining records. The network of nodes can be verified by the BC's every transaction. Once a transaction id added it can't be altered or modified. Tracking the delivery assets delivery can be made possible by BCT. Every transaction is recorded and it can't be altered when it is added due to its aspects.

Once the conditions of the argument are fulfilled, then SCs are self-executing contracts as it automatically executes themselves. The terms of contracts are simply encoded into the lines of the code, as it doesn't demand for any middlemen like banks or accountants. To ensure the effective digital asset delivery, SC created settings in terms of delivery, including the recipient's proof of receipt and the time and date of delivery.

The transaction on BC can be recorded by the delivering digital assets technique. This ensures that both parties have proof that indicates the asset has been effectively delivered and creates a record of the transfer that is resistant.

Improved security and reliability of the system was considered as the main benefits of the SC and BC utilization for POD. Due to BC's centralized aspect and transparency, hackers was unable to modify the record. It also ensures that both parties offer similar data. Deception and disagreements become less and it is considered as an issue by the result.

Transmitting digital assets can be done through the adoption of POD with BC and SC. By using this method, both parties can be confident that the transfer has been completed successfully, and there is a tamper-proof record of the transaction. Then, the trustability and reliability was provided by the BCT and SC, because it is self-executing as it directly transform into code.

Joseph E. Kaste et al.(3) characterized the construction and engineering industry as one of the most complex and heavily regulated industries in the world. The sector faces numerous challenges when it comes to integrating the physical and financial supply chains. The major risks are the absence of transparency and accountability across the supply chain. The traditional supply chain systems are plagued with inefficiencies, inconsistencies, and errors that creating as challenging for supervising the services transformation, manage inventory levels, and ensure timely payments. Fortunately, BCT has the ability to address all these challenges. The distributed ledger system or BC allows parties to deal with reliability and transparency and permenantly lessening them kiddle men requirements. Blockchain-based crypto assets, such as cryptocurrencies and tokens, offer several benefits that can help to integrate the supply chains of the physical and financial in the construction and industry of the engineering. One of the most significant advantages of BC-based crypto assets is their capability of enabling rapid, protected, and low-cost transactions. By BCT, contractors, suppliers, and other stakeholders can make payments in confident deprived of the intermediator necessities. This eliminates the need for costly and time-consuming manual processes, such as invoice processing, reconciliation, and dispute resolution. Blockchain-based payments also provide a higher level of security and transparency and every transaction is tracked on a permanent record, that cannot be altered or deleted.

Another advantage of blockchain-based crypto assets is their ability to enable automated and programmable supply chain processes.

The conditions of contract among the buyer and seller are automatically encoded into the lines of code in SC, because of self-executing contracts.It can be employed for automating SC procedures such as delivery of orders, inventory control and payment processing.For enhancing the engineering and construction sectors basic features SC can be designed. It can also permits the stakeholders in maximizing the functions of the supply chain's efficacy and cost efficiency.

The transparency as well as reliability of the supply chain can be offered by the blockchain-based crypto assets. On a public database, the all transactions can be done through BC.

Time payment verification in actual time, inventory level monitoring, and service transformation tracking for contractors, suppliers, and other stakeholders are also facilitated by this. BC's transapraency supports in lessening those challenges like threats, dishonesty, and fake. Permanent record cannot be altered or deleted, thus every transactions can be tracked on this permanent record.

Transforming the framework and engineering sector made possible through the physical and financial supply chains via BC-based crypto assets. BC lessen the costs, total efficiency and streamline chain procedures, as it provides fast,secure as well as low-cost transactions and automating supply chain procedures. Regulatory and

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technologoical barriers are the various risks involved, then the advantages of BC- crypto assets are considered to be the only possible solution for this sector.

Because of the ability for transforming various sectors particularly e-government services, BCT has gained more attention as stated by Dimitris Geneia takis et al.[4] Facilitating international trade as well as interactions among nations, e-government services plays an important role in this services. Still, there are many issues are available in the present technique. Those issues were: connectivity, privacy and security. Transparent and secure way for supplying this services offered by BC as it minimizes those risks. Implementing e-government services can be done through the utilization of BC performance analysis. This has been completely described in this paper.

Without the demand of any middleman, secure and open transactions can be promoted by the BC ledger system. 3 essential part of BCT: decentralized system, consensus procedure and SC. Due to the decentralized networks, multiple nodes can store and check transactions. As, it prevents suspicious users from misusing this structure. The transaction procedure is simplified by the SC. Every node consent on current state can be ensured by the consensus procedure.

The performance of BCT are considered to be the significant features. System's flexibility and efficiency are represented in the BC. The time required for analysing and verifying the transaction influences the way of swiftly evaluated system. The ability in managing various transactions can be done through the flexibility of the system.

The influencing factors in the execution of BC including:system latency, consensus technique and BC dimensions. Here, the consensus technique decides the procedure of BC's validated or adding transactions. Several consensus technique may differ from the efficiency and reliability.

As an instance, the application of bitcoin leads to the application of Proof-of-Work (PoW) consensus algorithm with the help of ethereum. Because it gives high security and less efficiency in comparison to the Proof-of-Stake (PoS) consensus procedure utilized by ethereum, as it offers high efficiency but low security.

The time taken for transferring node from one node to another can be defined as network latency. Processing and validation times transactions can be minimized by severe network latency. The application of several network protocols and network structure are employed in the BC procedure for the purpose of addressing this issue.

The performance gets impacted by the dimension of BC. When BC is broader, it becomed tough for transaction processing and validating. Then, BC systems may employ reduction, collaboration as well as several other methods for promoting international e-government services in the aim of mitigating BC. Various factors can be considered by BC performance analysis. Such factors include form of E-government services, the amount of users, and the legal framework. Finally, many E-government services may require huge amount of transactions whereas high level of security is not required by others. Then, the efficiency of the framework gets impacted by the international E-government services in conforming various legal structures. The ability to revolutionize E-government services and promoting international trade can be achieved by the BCT.

For the purpose of ensuring the systems security, reliability and flexibility, the study of BC performance is essential. For facilitating international E-government services, BC performance analysis may consider several including: service type, user count and the legal framework. For the purpose of international transactions with appropriate BC performance analysis, more effective and secure framework was offered by E-government services.

NFT (Non-Fungible Tokens) records and POD are becoming potential solution for the conventional issue in monitoring the fine jewellery's identity and validity as stated by Noura Alnuaimi et al.[5].

Then, the NFTs also known as digital recording constitute an indicator particular items or media works.

For the verification and identification of high value assets, NFT papers are employed in the fine gems and jewellery in authenticating the ownership of those items. Capacity to authenticate fine jewelry and diamonds, a crucial aspect in the premium luxury market can be achieved through NFT and it is considered to be the main benefits. Secure ownership record can be offered by the integration of BCT with NFT records. Through the integration, it is very difficult to recreate or fake. It will lead to the public trust in purchasing the expensive things like rare gemstones or beautiful jewellery. As, it has a vital part in making DM.

Ability for tracking gemstone or fine jewellery from its original source to its eventual owner can be done through the NFT's additional benefits. Providing useful information for the investors and buyers worldwide due to the verification of item's source. Through the utilization of BCT, NFT records offer a permanent records of ownership. It also supports in tracing piece's history across time. Finally, it also helps in preventing threats.

Another important aspect of trading for fine jewellery and gemstones are considered as POD. Maintaining a record delivery date and location is crucial when shipping valuable things. Then, POD helps in preventing those threats during transmission. Through the implementation of NFT, for seamlessly incorporating POD within the ownership record, achieves a trustworthy among buyer and seller while transmitting goods. POD is essential and application of NFT for trade consistency are considered as a challenges in this sector.

No universal standards are created or managed NFT records nowadays, as it provides inconsistent outcomes. To ensure that NFT certificates are globally utilized and recognized, efforts are created to set standards for it. Thus, NFT records and POD are the crucial elements for tracing the origin and validity of fine jewellery and gem stones. As, both can contribute in establishing trust and confidentiality.

NFT certifications are expected to become a typical part of the fine jewelry and gemstone sector as industry standards are adopted and technology advances. Digital twins (DT) are virtual copies of real-world items that can be utilized for a variety of tasks, including tracking, optimizing, and simulations, according to A. El Saddik et al.[6] It has been employed in several sectors including: transportation, healthcare and manufacturing.

Then, reliable, secure and sharing techniques is essential for the DT development as the above mentioned factors can be achieved by BCT. AS, BC offers reliable data sharing among several parties. Utilizing BC for storing as well as managing the information related to the DT for the purpose of BC-technique advancements. It provides several advantages and those benefits can be listed below:

Security: high level of security is offered by BCT as the data stored in the BC is permanent and it is unchangeable.

Transparency: all stakeholders engaged in the development and administration of DTs can access the same data due to BCT's transparency, which promotes cooperation and openness.

Traceability: by using a BC, data related to DTs may be tracked and traced, improving transparency and traceability.

For the purpose of DT improvements, the BC method may progress the security, efficiency and reliability also making best DM for both the sectors as well as organizations towards DT

Because of the revolutionizing capabilities across various sectors, BC and NFTs have gained more attention as stated by Ammar Battah et al.[7]. In the domain of AI models, it will promote trust, ownership and also supports in trading and its application.

A decentralized digital record BCT may be employed for the purpose of tracking transactions. It maintains a secure and transparency of records while transactions over dispersed network. As, it is permanent, in the absence of network consensus. The AI have the ability to bring trust, on the other hand it is very complex for understanding. Then, for the purpose of publishing models on the public BC, BCT was applied by the developers of AI models. Here, the users have the ability to ensure it. It depends entirely on the sellers assurance and also it permits them to track the product chosen for buying.

Due to the transparency of BC, it easily identifies the users and owners of model AI as it may be vital, when it seems to involves privacy and licensing concerns.

The ownership of specific asset was represented by the distinct digital tokens provided by NFTs. Representing and applying the AI model ownership due to the widespread application in the art and craft sector. NFTs permits users have the only access to the specific AI model, as it also represents the ownership. So, the buyers can acquire NFT.

On a variety of market places, buying and selling can be easily done through the utilization of NFT, as it also supports in trading AI models. Particular form of AI model was represented by the NFTs application, as it is unique. As, the AI models bring the trust on the view of buyers. For accessing AI models, both BC and NFT supports for this access. Accessing AI models with reliability and accuracy may be crucial specifically in the domains of the healthcare and finance.Legal access was ensured by the right people via BC and NFTs application.

The trusted ownership, trading and AI model access was capable of advancements in the domain via the utilization of BC and NFTs. AS, it also provides the trust among the buyers and sellers. By this confidentiality, the AI models will constantly develop with BC and NFTs field.

According to Senay A. Gebreabetal et al.[8] the healthcare sector is one of the broadest globally, with continual innovation and expansion in the field of medical equipment and technology. Medical supplies play a vital role in the identification, diagnosis, and treatment of a wide range of diseases and conditions. Their ownership and transparency are also essential for ensuring patient safety and regulatory compliance.

Traditionally, the traceability and ownership management of medical devices have relied on paper-based records and manual tracking, which can be time-consuming, error-prone, and susceptible to fraud. However, with the emergence of block chain technology and the advent of non-fungible tokens (NFTs), there is a new and more efficient way to track the ownership and traceability of medical devices. NFTs are unique digital tokens that are created on a block chain network, providing a secure and transparent way to represent ownership and transfer of assets. The use of NFTs in the health care industry can provide several benefits, including improved supply chain management, increased transparency, and reduced counterfeiting.

For traceability and ownership management of clinical devices, employing NFTs for can help to ensurethateachdevicehasauniqueidentifierthatisrecordedonablockchainnetwork.

This identifier can be used to track the device throughout its lifecycle, including manufacturing, distribution, and use. This can help to improve supply chain management and reduce the challenge of counterfeit devices arriving the shop. Additionally, the application of NFT scan help to increase transparency in the ownership and transfer of medical devices. Each NFT can represent a specific device and its ownership history, including information about the manufacturer, distributor, and end-user. This can help to ensure that each device is used by authorized person ne land is in compliance with regulatory requirements.

Moreover, the use of NFT scan also provide a secure and transparent way to manage the ownership and

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transfer of medical devices. Each NFT is unique and cannot be duplicated, ensuring that there is only one owner for each device. This may support in diminishing the threat of deception and ensure that the ownership of each device is accurately recorded and maintained.

In conclusion, there are a number of advantages to using NFTs for healthcare device ownership and traceability, including improved supply chain administration, more transparency, and a decrease in theft.

With the emergence of blockchain technology and the growing need for more efficient ways to manage medical devices, the adoption of NFTs in the healthcare industry is likely to increase in the coming years.

Marios To Ulo Upou et al.[9] presents three industry case studies where decision support was utilized for block chain platform selection. The first case study involves the healthcare industry, where a blockchain-based platform was selected to ensure secure and efficient sharing of patient data. The second case study is from the supply chain industry, where a blockchain platform was selected for improving transparency and traceability in the supply chain process. The third case study is from the financial industry, where a blockchain-based platform was selected to improve cross-border payments. In the healthcare industry, patient data privacy and security are of utmost importance. Therefore, a blockchain platform was selected to ensure secure sharing of patient data between healthcare providers while maintaining patient privacy. The decision support process involved evaluating different blockchain platforms based on their security, scalability, inter-operability, and regulatory compliance.

The selected block chain platform was also compatible with existing healthcare information systems, which made the implementation process easier. In the supply chain industry, transparency and trace ability are crucial for effective supply chain management. Therefore, a blockchain-based platform was selected to provide a transparent and trace able record of the supply chain process, including the movement of goods, ownership, and quality control. The decision support process involved evaluating different blockchain platforms based on their ability to provide real-time tracking, transparency, and tamper-proof records. The selected platform was also able to integrate with existing supply chain management systems, which minimized the implementation effort.

In the financial industry, cross-border payments are often slow, expensive, and prone to errors. Therefore, a blockchain-based platform was selected to progress the speed, cost- effectiveness, and security of cross-border payments. The decision support process involved evaluating different blockchain platforms based on their speed, cost- effectiveness, security, and regulatory compliance. The selected platform was also able to integrate with existing financial systems, which simplified the implementation process

In conclusion, decision support for blockchain platform selection is essential for organizations to recognize the ability of BCT. The decision support process involves evaluating different blockchain platforms based on various criteria such as security, scalability, interoperability, regulatory compliance, real-time tracking, and cost-effectiveness. The three case studies presented in this paper demonstrate how decision support can be utilized in different industries to select the most suitable blockchain platform for a specific use case.

Jinlei Sun et al.[10] shows the blockchain-enabled smart contracts as a revolutionary technology that allows for the creation of self-executin gagreements between woor more parties. SC are digital contracts that are self-executing and self-enforcing, meaning that they automatically execute and enforce the terms of the agreement without the need for intermediaries. They are based on block chain technology, which ensures that the contracts are secure, tamper-proof, and transparent. The architecture of blockchain- enabled smart contracts involves the use of decentralized networks that run on block chain technology.

These networks are made up of nodes that are spread across the globe, and each node has a duplicate of the BC ledger. When a smart contract is executed, the nodes on the network work together to validate the transaction as well as authorize that it is valid before it is added to the block chain. This decentralized architecture ensures that he contracts are secure and transparent since each node in the network may certify the validity of the transaction.

Smart contracts have a wide range of implementations through numerous businesses. One of the most popular implementations is in the financial industry, where smart contracts can be used to automate the execution of financial transactions like finances, assurance dues, and expenses. By using SC, financial institutions may diminishing the cost and time related with these transactions while improving their accuracy and efficiency. Smart contracts can also be used in the supply chain industry to automate the tracking of goods and ensure that they are delivered to their intended destination. This may help to reduce the threat of deception and also enhancing the accuracy of the supply chain, resulting in cost savings for businesses.

In the legal industry, SC may be employed to systematize the execution of legal agreements, such as property transactions, wills, and employment contracts. By using SC, legal agreements can be implemented more quickly and efficiently, reducing the time and costs associated with legal proceedings.

Looking into the future, the potential applications for blockchain-enabled smart contracts are vast. For instance, SC can be used to create decentralized autonomous organizations (DAOs), which are organizations which activate exclusively on the BC without the need for intermediaries or human intervention. This could revolutionize the way that businesses and organizations are run, providing more transparency and efficiency.

Inconclusion, blockchain-enabled smart contracts are evolutionary technology that has the potential to transform various industries. They offer a secure, transparent, and efficient way to execute and enforce agreements, decreasing the time and costs related with traditional intermediaries. The potential applications for smart contracts are vast, and we can expect to see more widespread adoption of this technology in the future.

METHODOLOGIES

The fundamental idea with BCT lies in the fact that it allows characters that appear on screen to use computer resources through a P2P structure that saves these trades appropriately across the network (referred to as hubs).

The traditional method consists of in person evaluation of the documents and in person validation of the buyer and the seller and inspection officer, the documents are stored in a paper format which the integrity of the document is not assured since there are many ways the document could be forged or destroyed. And the security concerns in many areas like defrauding the end entities and forging of the documents and even selling the property higher than the required amount of the property which is listed.

Open key cryptography and advanced indicators are employed to authorize the owner of the assets and to facilitate the transfer of possession. ABC transactions in its entirety is seen in figure 1, as every block gets processed and authorized by the network's nodes through transaction validation.

Then no de receives are ward for the proof of validation and then block is added to existing chain and a transaction is completed. Ethereum is found to be efficient to prove security and decentralization properties but scalability is still a challenging aspect to be proved.

The primary reasons for the false situation with LR systems are improper data collection, the compilation process, analyzing, and usage.

Inefficient due to heavy reliance on multiple third parties. High transaction costs between the parties (Seller to Inspector, Inspector to Buyer) Apro longing of the time in which property transactions are completed in. and using this system there are a large amount of resources, effort and time is consumed, The main issue in existing system is security concerns since there is no guarantee that the entire process goes in a correct flow, sometimes the integrity of the documents and the third parties within the registration may defraud the end client and even the seller.

Disadvantages of existing system

- Lengthy and complex process
- Manual Documentation
- Lack of transparency
- Limited Accessibility
- Lack of Standardization
- Limited Data integrity

The phrase "LR records" can be defined as a set of official records kept and managed by government agencies that provide all pertinent information on a piece of assets, including the present legal owner of the asset or property. Obtaining knowledge about the land's previous owners and their historical ownership history is beneficial.

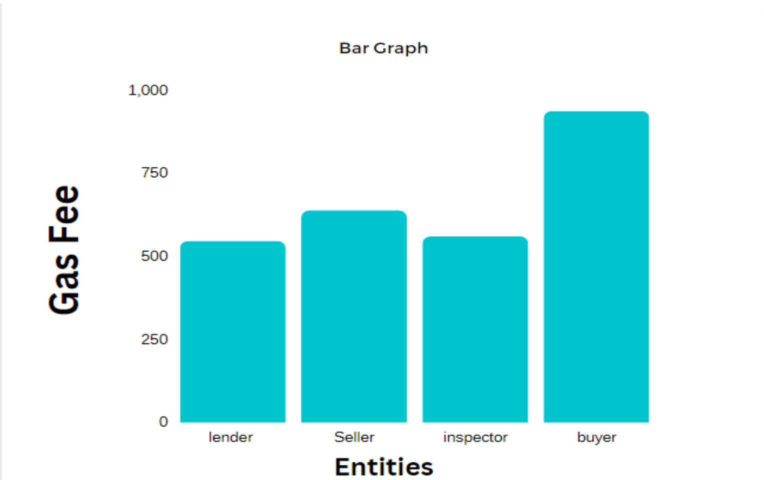

Figure 1. Gas Fee Usage Chart

The ownership rights are transferred from one person to another. The data kept in the legally binding documents, which remain susceptible to manipulation Making certain that everything runs smoothly and openly. cultivated a relationship of trust among the parties since transactions take the shape of clear contracts.

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prevents changing data that has already been recorded. enhances data security and guarantees the land records' validity, deal with each other without having to have faith in the other person or organization.

By using this approach we can also reduce the cost of the gas, which is also known as computational effort or to perform an operation in the block chain network, every operation or an transaction which happens on the blockchain which requires a certain amount of gas which is spent on any operation on blockchain, currently, the sellers sells his property an certain amount of gas is used, Similarly when an inspector inspect and approves an property and when a lender lends and the buyer buys the property a certain amount of gas is spend, when using this proposed system these are the gas amount which is spent during in process of each operation.

Design process

Overall systemarchitecture

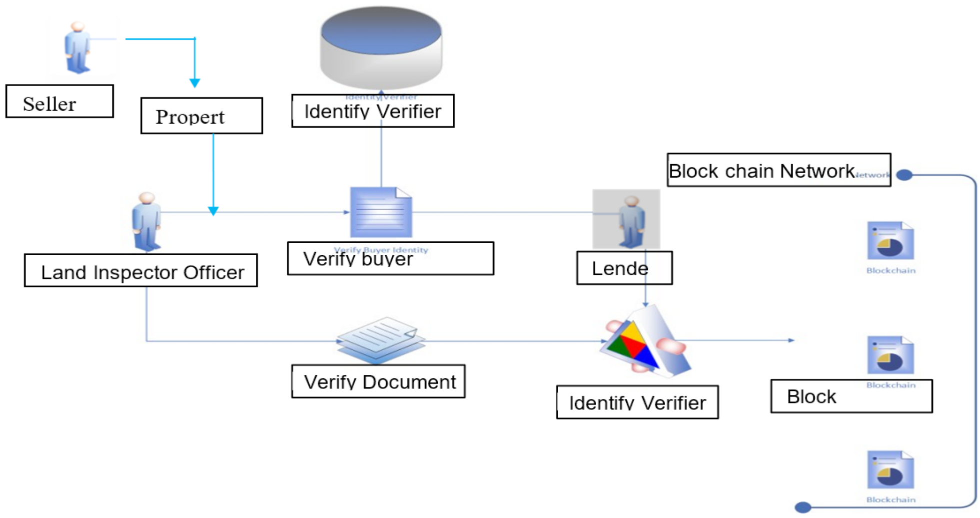

Figure 2. System Architecture

The System architecture for land registration using blockchain network consists of first the land registration officer is used to record and validate the documents and the identity of the buyer, then the after verifying and approving the hashed block is added to the blockchain The foundation of the architecture is ad ecentralized block chain network, such as Ethereum.

It provides a distributed ledger where land registration transactions are recorded and verified by network participants. Smart contracts are self-executing agreements deployed on the BC. They define the business logic and rules for land registration processes, including ownership transfer, escrow management, and inspection verification. SC permit computerized and trustless interactions among the participants.

Seller: Seller is an entity who sells the property which he intend to send, here the seller can provide the necessity documents, pictures and information which can be enlisted

Land Inspector Officer: inspector officer are the one who will inspects the documents and the pictures and verify all the necessary information which can be approved to sell,

Lender: lender is an entity who are a middle man between the seller and buyer's they lend the particular property which is approved by the officer.

Buyer: buyer is the person who buys the property which is approved by inspector officer, between buyer and seller there are this many steps to achieve the entire process.

Blockchain Network: a dispersed, decentralized digital ledger that safely records transactions across numerous computers, or nodes, is called a blockchain network. It is intended to give P2P networks without the need for middlemen openness, reliability, and trustworthiness.

Block in blockchain: a block is a fundamental component that stores a collection of transactions or data. A block contains several key elements. Firstly, it includes a unique identifier called a block hash, which is generated using a cryptographic hash function. The block hash certifies the trust and reliability of the block by linking it to the previous block in the chain.

Moduledescription

Escrowcontract

This is a smart contract named ESCROW, which simulates the functionality of how real escrow would interact a trustable middle agent.

1. The contract defines several addresses, including the NFT contract address (nft Address), seller's

address (seller), inspector's address (inspector), and lender's address(lender).

2. The Smart contract includes three modifiers: only Buyer, only Seller, and only Inspector, which restrict access to specific functions based on the sender's address.

3. The contract uses various mappings to store information related to listed NFTs, including whether an NFT is listed (isListed), its purchase price (purchase Price), escrow amount (escrow Amount), buyer's address (buyer), inspection status (inspection Passed), and approvals from different parties(approval).

4. The constructor function initializes the contract by setting the NFT address, seller's address, inspector's address, and lender's address.

5. The list function permits the buyer to list an NFT for sale. It transfers the NFT fromthe seller to the contract, sets the listing details (is Listed, purchase Price, escrow Amount,buyer), and requires payment from the seller.

6. The deposit Earnest function allows the buyer to deposit the escrow amount for a specific NFT, ensuring that the deposited amount is equal to or greater than the required es crow amount.

7. The approve Sale function allows any address to approve the sale of an NFT by setting the approval mapping.

8. The update Inspection Status function allows the inspector to update the inspection status of an NFT.

9. The finalize Sale function finalizes the sale of an NFT, requiring successful inspection, approvals from the buyer, seller, and lender, and sufficient contract balance. It transfers the payment to the seller and transfers the NFT to the buyer.

10. The cancel Sale function cancels the sale, refunding the escrow amount to the buyer if the inspection failed or returning funds to the seller if the inspection passed.

11. The receive function allows the contract to receive Ether.

12. The get Balance function returns the current balance of the contract.

Real estate

This is a smart contract called REAL ESTATE that extends the ERC721 and ERC721URIStorage contracts from the Open Zeppelin library

1. The contract imports the necessary libraries from Open Zeppelin: Counters for managing token IDs and ERC721URIStorage for storing and managing token metadata.

2. TheRealEstatecontractinheritsfromERC721URIStorage,whichisanextensionoftheERC721contract. ERC721isthestandardfornon-fungible tokens(NFTs)on the Ethereum blockchain.

3. The Counters library is used to manage token IDs. The private _tokenIds counter keeps track of the current token ID, ensuring each token has a unique identifier.

4. The constructor function initializes the ERC721 contract with the name "Real Estate" and the symbol "REAL."

5. The mint function allows users to generate new NFTs representing RE assets. It takes a token URI parameter, which identifies the metadata URI for the token. The function increments the token ID, mints a newtok en to the sender's address, and sets the token URI.

6. The _set Token URI function from ERC721URIStorage is used to associate the provided metadata URI with a specific token ID. The metadata URI typically includes data about the RE asset, including its description, images, and other relevant data.

7. The total Supply function returns the current number of tokens minted by retrieving the value of token Ids.

Deployscript

1. The required modules are imported, including the Hardhat library for Ethereum development (ethers) and the Hardhat Runtime Environment(hre).

2. The fetch Data function is defined to fetch data from a specific endpoint using a GET request. It returns the fetched data as a JSON object. The tokens function is a utility function that converts a numerical value into the equivalent Ethereum token amount using the ethers.utils. parse Un its function.

3. The main function is defined as an a synchronous function that performs the main tasks of the script. In the Main Function Accounts for buyer, seller, inspector, and lender are retrieved using ethers. Get Signers().

4. InthefetchDatafunctioniscalledtofetchdatafromaspecifiedendpoint.Theresultis stored in the houses array.

5. The "Real Estate" contract is deployed using the Real Estate contract factory obtained from ethers. Get Contract Factory. The contract is then deployed using the deploy method, and its address is logged.

6. The script proceeds to mint NFTs (representing properties) using the deployed "Real Estate"

contract. It loops through the houses array and calls the mint function of the contract to mint a new NFT for each property. The URI of each NFT is set using the endpoint fetched from fetch Data.

7. The"Escrow"contract is deployed using the Escrow contract factory obtained from ethers. get Contract Factory. Similar to the "Real Estate" contract, it is deployed and its address is logged.

8. The script proceeds to list properties for sale using the "Escrow" contract. It calls the list function of the contract for each property, providing the necessary parameters such as the property ID, buyer address, purchase price, and es crow amount.

METHODOLOGIES

Module 1: Master Setup

Initially, the users should register themselves with Blockchain wallet connection i.e., A blockchain wallet is not like a traditional physical wallet that stores physical money or cards. Instead, it stores private keys that allow users to access and manage their digital assets on a blockchain network.

Private keys are cryptographic codes that allow a user to prove ownership of their digital assets and authorize transactions on the blockchain network. Buyers will have the opportunity to transfer land ownership after registration is complete. Before a conveyance deed is executed, buyers must submit their information to a land inspector for document verification. After the land inspector verifies the documentation, the seller will be contacted.

Module 2: Smart Contract Creation

After identifying the actors, concepts and events related to the process, the system smart contracts are produced. An oracle-driven, static, or dynamic SC can be designed by the developer, according to the specific application that needs to be realized.

Asmart contract is a pre-written computer program that enables digital transactions under particular conditions or terms. With out requiring human interaction, smart contract senable the tracking and implementation of complex agreements between parties. In a buyer-seller transaction network, SC implemented within a BC-based technology may assist company logic operate themselves.

Encapsulating and protecting information and keeping it simple throughout the network is the primary goal of smart contracts. SC are typically employed to implement business logic that must be verified before a block is created on the BC.

It is customary to use concepts like features, functions, modifications, and incidents while creating a SC. A system's features are stored attributes that allow values to be changed and saved. A function is a series of instructions or procedures. A function executes the action specified in the function body when it is called. The next two in line are modifiers and incidents, which allow the BC transaction log to store almost anything. An event results in the creation of data. After that, the information is directly added to transaction logs, preserving past data that can be retrieved at a later time. This triggering of events makes the structure auditable. Smart contract modifiers enable the functions' behavior to be modified.

It has several uses, such as restricting that can execute a particular function or unlock features after a predetermined amount of time.SC are quickly implemented after all conditions of the agreements are met. This gets rid of the requirement for an outside party. The BC provides an encrypted framework for data storage and preservation, and the SC leverages its terms to administrate the network like a corporation.

Module 3: Blockchain Creation

BCT and the RE industry have come together to provide a novel, fast, and secure approach that might greatly reduce technical theft.

This CET(SC) reduces the interval between executing the preliminary sales contract and streamlines the information transferring procedure for RE. New digital architecture makes it possible for RE transactions to be automated.

Users are able to access the transferable parcels and enter the BC after their details have been validated. The suggested system would place special emphasis on SC, which are tone-executing contracts and it is directly included into lines of legislation with the terms of the contract among sellers and buyers. Different edge conditions related to the exchange of land and property are handled using a distinction-free technique.

The technology strictly maintains to the decentralized aspects of the Bitcoin BC through the channel of reality consensus for every sale. The system's data will only be accessible to BC members. Members who are not within the visual range will only be able to view the trade packets by paying to be enrolled in the blockchain. This will prevent unauthorized individuals from accessing the blockchain in the restricted zones. The authorization system redefines the fundamental idea of access control for a trustworthy datastore.

Implementation

Defining the System Requirements

Begin by defining the requirements of your land registration system. Identify the key functionalities, such as registering land parcels, transferring ownership, and verifying land documents.

This will serve as a foundation for the development process, and find out who are the entities behind the registration process, Identifying entities like the lender, buyer, seller, inspector so that the smart contacts can be written based on the properties of those entities.

Escrow solidity smart contacts takes care of the trustable interaction between these entities, since escrow is a trustable middleman, and extend the process if one has performed his operation successfully without any rejection and any changes in between the process

Setting Up the Development Environment

The setting up the environment is the first step use command npx create-react-app land-registration which will create an react application and clear some unused files, Create a new React.js project using Create React App.

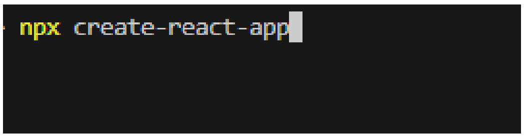

Figure 3. Creating react app

Set up Node.js and npm (Node Package Manager) on your machine. Download node and check for the latest version “npm -version”, then install any dependencies using “npminstall”. Then us enp mor node to install needed libraries like npmireact-router- dom , install hardhat framework Install the necessary tools and dependencies for development.

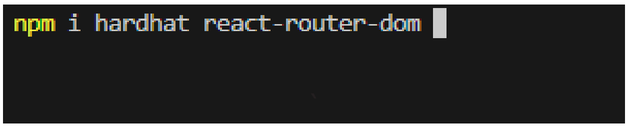

Figure 4. Installing hardhat using node

Then connect or add extension of the metamask wallet in the browser extension. And login metamask wallet with your account.

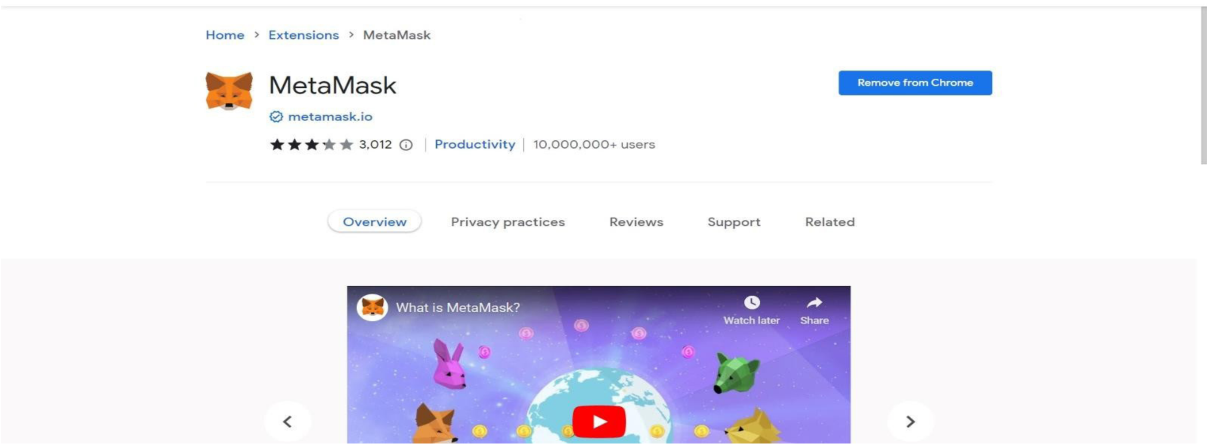

Figure 5. Installing metamask wallet

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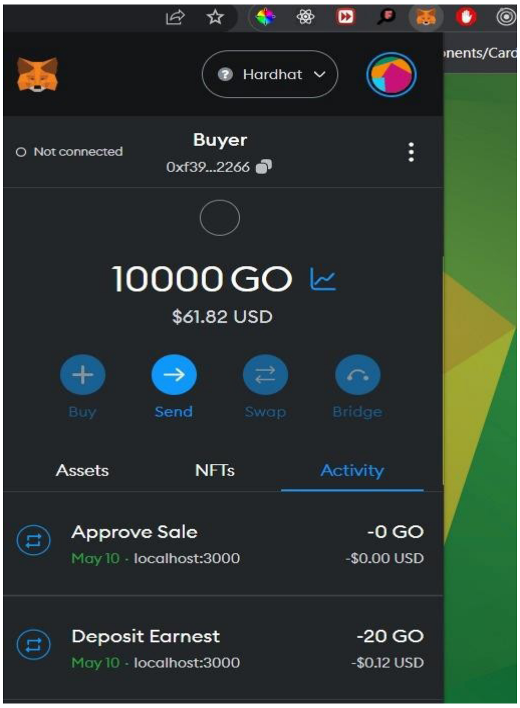

Figure 6. Metamask extension

First you will test the framework "npx hardhat test", then you will start the framework using "npx hardhat node", then you will deploy the local network using "npx hardhat run .scripts/deploy.js -network localhost".

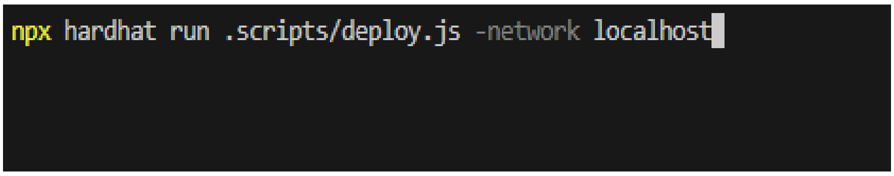

Figure 7. Deploying deploy script

Designing the Smart Contracts

The provided Solidity code represents a smart contract called "Escrow" that actsas an intermediary for secure transactions of non-fungible tokens (NFTs). It allows users to list NFTs for sale, deposites crow amounts, approve sales, update inspection statuses, finalize sales, cancel sales, and check the contract's balance.

The contract utilizes the ERC721 and ERC721URIStorage contracts from the Open Zeppelin library, which are standards for NFTs on the Ethereum blockchain. It manages token IDs using the Counters library to ensure uniqueness. The contract is initialized with the name "Real Estate" and symbol "REAL" through the constructor.

Users can create new NFTs representing real estate assets by calling the mint function and providing a token URI, which specifies them eta data associated with the token. The token ID is incremented, and the token is minted to the sender's address with the corresponding token URI.

The_set Token URI function isused to associate the meta data URI with a specific token ID, allowing users to access information about the real estate asset. The total Supply function returns the current count of minted tokens.

In summary, the contract enables the creation, management, and transfer of NFTs representing real estate assets, providing functionalities for secure transactions and metadata storage.

Writing and Testing Smart Contracts

Write the Solidity smart contracts for your land registration system. Define the contract structure, functions, and data structures required to handle land registration and ownership transfers.

Define the contract structure: Start by specifying the version of Solidity you are using at the top of the file using the pragma statement. For example: pragmasolidity^0,8.0;.

The Escrow contract facilitates the escrow process for the sale of land tokens. It handles the listing, deposit, approval, inspection, and finalization of land sales.

The Land Registration contract handles the creation and management of land tokens. It extends the ERC721 contract to enable non-fungible land token functionality.

Implement necessary validation and access control mechanisms to ensure security. Write comprehensive unit tests using Hardhat.

Building the Front-End withReact.js

Develop the user interface using React.js. Design and implement the screens and components required for users to interact with the land registration system. React js uses jsx which is javascript xml which is a syntactic language which allows user to write code in a understandable way the files ends with the extension of. jsx

Connect the front-end with the BC using Web3.js or Ethers.js libraries to interact with the SC used on the Ethereum network.

Implement functions to read and write data to the block chain, such as registering land, transferring ownership, and retrieving land details. And update the user interface as per as the requirement is needed Create and maintains per ate components for each functionality like home, card, single card and handle all the api call in try and catch block and check for re renders of the application Since it may call the api from the backend again and again and check for the updates which are needed to be conditionally rendered in the react application.

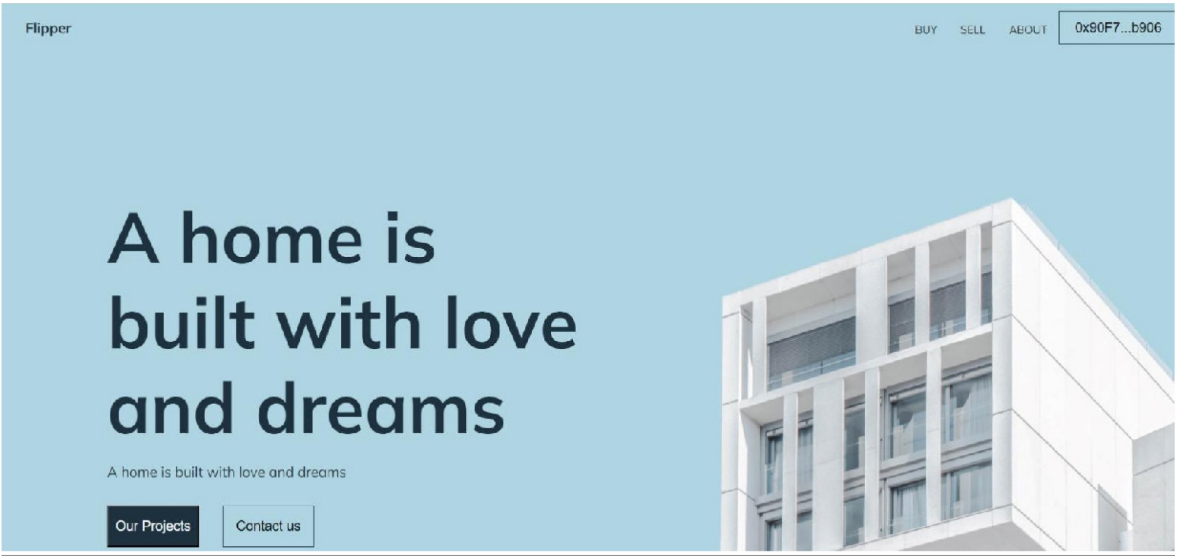

Figure 8. Frontend design

Integrating with Hardhat

Integrate your React.js front-end with the Hardhat development environment. Configure the Hardhat project to deploy your smart contracts to a local blockchain network, such as custom local blockchain, Once the basic setup is complete, the next step is to establish a connection between the React.js application and the Ethereum blockchain. This is achieved by importing the web3.js library into the React.js project and utilizing it to create a provider that connects to the desired Ethereum network, whether it be a local development network, a test net, or the main net. This connection allows the React.js application to communicate with the blockchain and interact with smart contracts.

Now that the connection is established, you can import the compiled artifacts of the deployed smart contracts into the React.js project. These artifacts contain the contract's ABI (Application Binary Interface) and address. The ABI defines the functions and data structures of the smart contract, enabling the React.js application to understand and interact with it. The contract address is necessary to instantiate the contract and create an instance of it in the React.js application. With the SC artifacts imported, you can now utilize the web3.js library to interact with the SC from the React.js components. This includes calling contract functions, reading data from the blockchain, and sending transactions to update the state of the contract.

The integration enables seamless communication between the front-end user interface and the blockchain, allowing users to inter act with the land registration system through a user-friendly interface while ensuring the integrity and security of the underlying blockchain technology.

Testing and Debugging

Use the deployed SCs to test the LRS. To verify that the functionality of the system is operating correctly, run automated tests using the testing tools that Hardhat has given.

Debugany issues or errors that ar iseduring test in gandre fine your contracts and front- end code accordingly.

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Enhancing Security and User Experience

To protect the privacy and reliability of user data, put in place extra security measures like encryption and role-based access limitation.

Ensure that the contract deployment processis secure.Useappropriateauthentication mechanisms to verify the identity of the deploying entity. Consider implementing a multi-signature scheme where multiple parties need to approve the deployment.

Implement robust input validation mechanisms in your React frontend to prevent malicious inputs and ensure data integrity. Validate user input before interacting with the blockchain, both on the client-side and server-side, to avoid potential vulnerabilities.

Implement comprehensive error handling in your React application to provide meaning full error messages to users in case of failures or exceptions. Display clear and informative notifications to guide users through the registration procedure and address any issues that may arise. Design a user-friendly interface for interacting with the land registration blockchain system. Provide clear instructions and intuitive workflows to guide users through the registration process. Use proper form validation and provide informative feedback to users.

RESULT AND DISCUSSION

The final results from improving the old traditional approach of registering land has become much easier and simple and even more secure than the previous approach, where the lender, buyer, seller and even inspector can do their work remotely within a click of a button without even spending extra resources and time

Bythisapproachormethodologynnumberoflandcanbesoldandregisteredwithinashortperiodoftime,compared to the time span the previous or the traditional approach would take place, and there is no chance in defrauding since blockchain is used their activitiesistransparentandtheirusageisalsosecuredsinceusageofsmartcontractand hashing takes place.

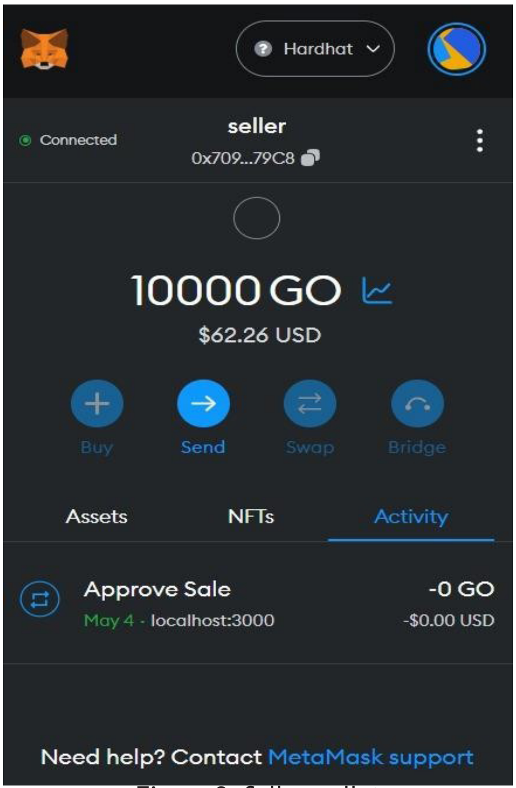

Figure 9. Seller wallet

This is the wallet or the digital Money of the seller.

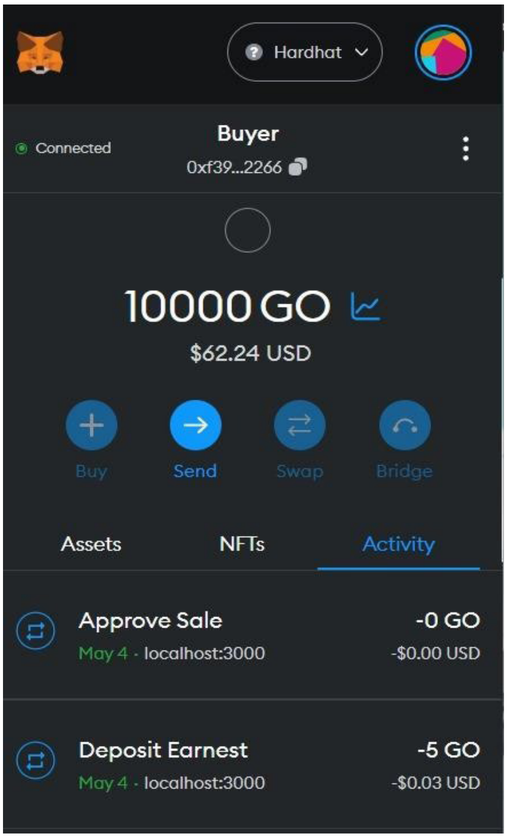

Figure 10. Buyer wallet

This is the wallet of the buyer who is interested in buying a property.

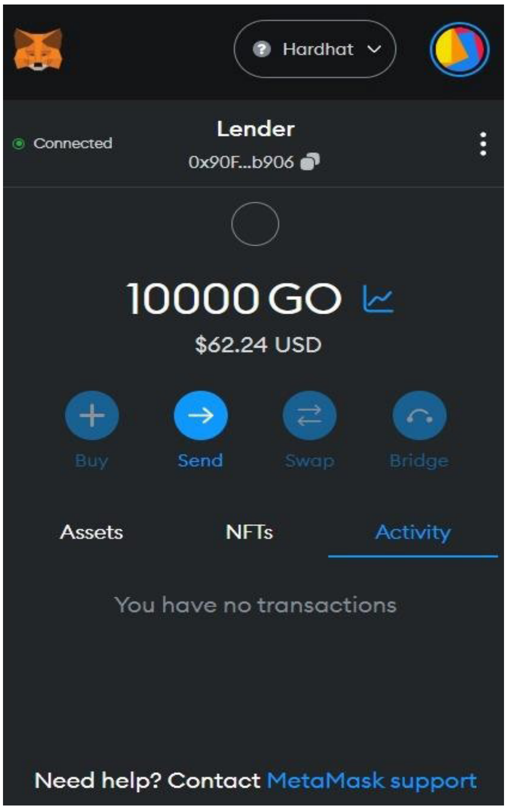

Figure 11. Lender wallet

This is the wallet of the Lender who lends a property.

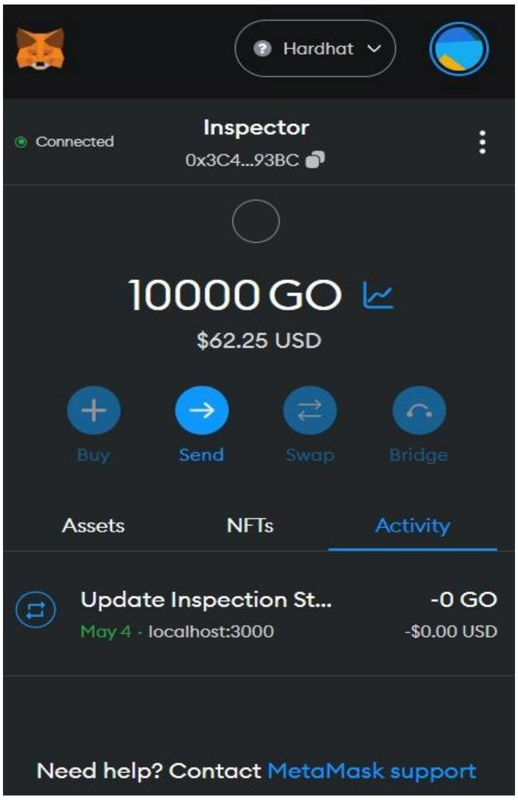

Figure 12. Inspector wallet

This is the wallet of the Inspector who inspects the particular property and documents.

All these people instead of being in person and handling all these process and spending their time and resources in buying a land, All these process is simplified and done by using this method and having digital money i.e Ethereum, smart contracts to handle all these operations, as per no broker statistics it would takes approximately four months, but using this approach and checks for extra security it would take few days to complete this process if all the entities are available.

DISCUSSION

Transparency and Immutability: the decentralized nature of the blockchain guaranteed transparency in land transactions. as a result of everyone in the network having access to the same data, there were no inconsistencies and no chance of fraud. The integrity of the registration process was improved thanks to the blockchain's immutability, which prevented unauthorized changes to land records.

Less Administrative Work: by utilizing blockchain technology, the system significantly lessened the administrative work required by conventional land registration procedures. The process was stream lined by doing away with voluminous paper work and manual record-keeping, saving time and effort for both users and administrative entities.

Simplified Procedures and Increased Efficiency: the application of SC automated the execution of real estate transactions, doing away with the need for middlemen and shortening registration wait times. Quicker ownership transfers and updates to land data were made possible by the system's more effective and organized workflow.

Real-time Access to Land Registry Data: all authorized stakeholders now have real- time access to LR data thanks to the blockchain-based system. Decision- making procedures like property evaluations, loan requests, or land development planning were made faster as a result. The accessibility of current data increased trust and transparency among parties involved in land transactions.

CONCLUSION

Regulatory compliance and the legal framework: blockchain technology adoption for land registration necessitates a favorable legal environment and regulatory observance. To establish blockchain-based land records as legally enforceable and bindable, the government and relevant authorities must enact the necessary laws and regulations. Akey component of block chain technology's successful implementation is ensuring that it is compatible with the decentralized nature of current property laws.

The security and privacy of data: data privacy and security are crucial because land registration involves private, sensitive personal and real estate-related information. To certify the privacy of user data, it is crucial to implement strong encryption methods, access controls, and privacy safeguards within the block chain infrastructure. To foster trust and safeguard people's right to privacy, compliance with data protection regulations should be given to priority.

Infrastructure scalability: a significant challenge is scaling the BC-LR system to handle the enormous volume of land transactions in India. For the system to be widely adopted and run smoothly, it is imperative to address scalability issues and make sure that high-performance, dependable blockchain infrastructure is available. To overcome scalability challenges, partnerships with technology providers, infrastructure development, and continuous optimization are essential.

User adoption and education: user education and broad adoption are necessary for the BC-LR system to be implemented successfully. Education about the advantages and operation of the new system is required for all stakeholders, including landowners, buyers, sellers, and government officials. The smooth user adoption and effective system use can be ensured by training programs, awareness campaigns, and user-friendly interfaces.

Integration with Current Systems: integration with current property databases, land administration systems, and government processes is essential if blockchain technology is to fully realize its benefits. For diminishing effort duplication and progressing the advantages of the blockchain-based system, collaboration between government agencies and blockchain developers is crucial for seamless integration and data synchronization.

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AUTHORSHIP CONTRIBUTION

Conceptualization: R.Akila.
Data curation: J. Brindha Merin.
Formal analysis: J. Brindha Merin.
Research: J. Brindha Merin.
Methodology: R.Akila.
Drafting - original draft: R.Akila.
Writing - proofreading and editing: J. Brindha Merin.