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Tokenizing The Future: Advancing AssetManagement With Blockchain

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Abstract—Management of assets like lands, apartments, shops, and other intangible assets, in India as well as in other parts of the world is a very slow and tedious process involving a lot of intermediaries. The development of a system that expedites the registration of an asset and streamlines the transfer of ownership between buyers, sellers, and government authorities can only be achieved through the creation of a distributed system that securely stores all transactional data in an immutable ledgerwhich is secure, transparent and efficient. This paper outlines theimplementation of an asset transaction and management system utilizing the Ethereum blockchain and smart contract technology. The Ethereum blockchain stores the details of all transactions whereas the smart contracts triggers various events like accessof asset-related documents to the asset inspectors and transferof funds from a buyer to a seller after successful verification of the buyer, seller, and the asset.

Index Terms—Web Application, Blockchain, Asset Manage- ment, Application Programming Interface (API), Ethereum Vir- tual Machine (EVM). Ethereum, ETH, InterPlanetary File Sys- tem (IPFS), Non-Fungible Token (NFT), Solidity, Smart Con- tracts

I. Introduction

Assets and their management play an indispensable role in the realm of finance and business. Assets are those valu- able resources or items which are owned by organizations or individuals and have the potential to generate economic benefits in the future. Such economic benefit bearing re- sources include physical assets for example real estate like land, building, residential apartments etc or inventory or equipment. The other types of assets are intangible assets such as intellectual property, patents and brand recognition [16,17]. Effective management of assets requires strategically monitoring, maintaining, and optimizing these resources toaugment their value and maximize returns. Over the past few decades, the asset management industry has experienced an impressive growth in size and complexity. In order to meet the diverse global demands of investors, there has been an expansion of fund structures and exposure to underlying asset classes. This expansion has led to major dependenceon service companies as intermediaries between the industry and the clearing and settlement infrastructure. In

the context of transferring ownership, a meticulous process is required to ensure a smooth and legally binding transition of assets. This transfer of ownership generally involves a transfer of title or rights from the current owner to the new owner. Methods of transferring ownership could include sales, inheritance, gifts, or even mergers and acquisitions in the corporate world. To facilitate the transfer of ownership, proper documentation, legal agreements, and compliance with relevant regulations are essential. These measures ensure the accurate recording of asset transfers, protect the rights of the parties involved, and provide a clear chain of ownership. By managing assets effectively and executing proper transfer processes, individuals and organizations can safeguard their investments and optimizetheir asset portfolios [18].

II. Literature Review

Harnessing the power of decentralized systems and blockchain to overcome existing limitations and problems relating to the management and transfer of assets has been the topic of many discussions and research in recent years. Numerous scholars, entrepreneurs, and experts have provided insight into combining the features of blockchain to improve the current systems in use.

A. Tran et al. [1] describe the application of blockchain as a distributed ledger to overcome the lack-of-trust issuesin various asset management processes of businesses. This methodology can be applied to both fungible assets like cryp- tocurrencies (Bitcoin, Ether, etc.) or tokens, as well as non- fungible assets (cars, houses, land, etc.). They also propose a Model Driven Engineering (MDE) tool named Lorikeet, to automatically generate smart contracts for existing business logic.

P. Kuhle et al. [2] propose a Blockchain-based asset man- agement system for commercial aircraft leasing, an area where conflicting interest between many competing parties creates an implicit lack of trust, thus requiring a framework to promote transparency and mitigate the shortcoming of existing policies and their enforcement. The solution uses a consortium blockchain with an architecture consisting of clients with transactor permissions, transaction processors, and validators, to create a robust and functional system.

Y. Zhu et al. [3] propose a digital asset management systemthat combines the benefits of Blockchain with Attribute-Based Access Control to provide more secure and diverse permission management along with transparent and decentralized autho- rization. They present a transaction-based access control model to handle transactions regarding registration, escrowing and publication, and finally access requests and grants.

V. Zakhary et al. [4] explore the possibility of using a combination of permission and permissionless blockchains to manage assets other than cryptocurrency units. A government-authenticated permissioned blockchain is used to manage the registration of users and assets, while the end users can perform transactions on their assets using function calls writtenin smart contracts.

A. Shojaei et al. [5] propose a model to use blockchain as the infrastructure to improve built asset sustainability by harnessing the features such as transparency, immutability, and reliability. By using blockchain as a transparent and comprehensive database one can accurately evaluate built assetsustainability.

D. Verma et al. [6] explore the utility of using a blockchain- based system to manage the dynamic sharing of assets among coalition members while following the policy constraints set by different coalition systems. Blockchain allows a mechanismfor trustless parties to validate transactions without requiring an overseeing body, which is invaluable in global allies boundby foreign policies.

A. Raslan et al. [7] describe the possibility of using blockchain technology in the Architecture, Engineering, and Construction (AEC) sector for closing the gap between Building Information Management (BIM) and Asset Infor- mation Management (AIM). The use of blockchain adds non-repudiation, confidentiality, change tracking, recording, and data ownership to the asset management process which contributes to better decision-making and efficient communi- cation.

D. Wijaya [8] proposes a method to extend the functionalityof the bitcoin blockchain to manage the transaction of other arbitrary assets by embedding them into Bitcoin transactions. This method is more efficient in transaction fees and saves more than 18 percent when compared to the normal Bitcoin Messaging Protocol.

R. Kumar et al. [9] discuss the viability of an Inter-Planetary File System (IPFS) based blockchain storage model to allow the storage of large documents and transactions in an efficient and secure manner to reduce the amount of space occupied over the blockchain. Files stored in such a manner can be shared with authorized persons using the generated content-addressed hash which can be used to authenticate the document as well.

Digital Asset Management with Distributed Permission over Blockchain and Attribute-Based Access Control [10], discusses the challenges of managing digital assets in the booming global internet economy and presents a new digital asset management platform called DAM-Chain. This platform amalgamates the ABAC distribution model with the advanced blockchain technology to offer a plethora of authorization mechanisms for digital assets that are stored in blockchain. Moreover, the transactions that take place in the blockchain serve as a reliable and traceable medium for accessing re-quests. The system might face security, regulatory and legal challenges if the platform is not implemented and maintained properly.

III. Blockchain Technology

Blockchain is a decentralized, unalterable record-keeping system that facilitates the management of transactions and as- set monitoring across a network of enterprises. This asset may be either tangible or intangible; in essence, anything with value can be registered and exchanged on a blockchain network. Consequently, this approach reduces the possibility of risk andminimizes expenses [11]. Ergo, blockchain technology ensures the transparency, immutability, and integrity of data without the involvement of a central authority or intermediaries. Each transaction in the blockchain ledger is sanctioned by the digital signature of the owner, which verifies the transaction andshields it from manipulation, making it highly secure. Unlike conventional methods where a regulatory body monitors and approves or rejects transactions, in blockchain technology this dependency on regulatory bodies is replaced by mutual con- sensus of the users in the blockchain network [12]. This mutual consensus is a software application utilized in blockchain systems to attain widespread concurrence pertaining to the ledger's condition. Typically, it is executed within a network encompassing numerous procedures and users [13]. The main aim of consensus algorithms is to replace much slower human verifiers and auditors. Blockchain is of three types: publicor permission-less blockchain which allows anyone to join the network without any restrictions. Most cryptocurrencies run on public blockchains which are governed by consensus algorithms. Private or permissioned blockchains are governed by organizations and users need special permission to access specific sets of data or to join the network. A Federated or consortium blockchain is a blockchain network where the consensus is controlled by a pre-selected set of nodes or stakeholders [14].

Smart contracts are computer programs that execute con- tract clauses automatically once predetermined conditions are met. These contracts are composed of transactions and are stored, replicated, and updated across distributed blockchains. Unlike traditional contracts, which require the involvement of a trusted third party in a centralized manner, smart contracts
do not suffer from this limitation, resulting in shorter exe- cution times and lower costs. The integration of blockchain technology with smart contracts will enable the realization of a "peer-to-peer market." [15]

IV. Current Approach

The current system of asset management requires knowl- edge of several legal statutes including but not limited to Registration Act, 1908; Stamp Act, 1899; General Clauses Act, 1897; Transfer of Property Act, 1882; etc. This approach gives rise to

several middlemen in the processes of asset management and transfer of assets in the form of registrars, brokers, lawyers and many more. Such a system presents several limitations and challenges. Firstly, brokers charge significant brokerage fees, making the process expensive for the parties involved. This aspect hinders the accessibility and affordability of asset transac- tions, especially for individual buyers and sellers. Moreover, the transfer of assets in the existing system is often time- consuming and cumbersome, taking days to weeks to com- plete. This delay can be attributed to various factors such as manual paperwork, verification processes, and the reliance on intermediaries for transaction facilitation. As a result, the efficiency and promptness of asset transfers are compromised. A significant concern in the current approach is the vul- nerability to document tampering, leading to unauthorized changes in ownership. Instances of asset robbery and fraud-ulent activities have been reported due to the manipulation of documents. This poses a substantial risk to the integrity and security of asset transactions, undermining trust betweenparties. Additionally, the limitation of access to available assetsis a prevalent issue in the current system. Buyers heavily rely on their brokers to present a limited sample space of assetsfor sale, restricting their choices and potentially missing out on suitable opportunities and allowing for manipulation of the market. This lack of transparency and comprehensive asset visibility reduces market efficiency and hinders the buyer's ability to make informed decisions. To address these chal- lenges, this research project aims to implement a blockchain- based asset management system. By leveraging the advantages of blockchain technology, te application strives to elimi- nate the need for intermediaries and provide a decentralized platform for asset transactions. This approach significantly reduces brokerage fees, enhances transaction speed, ensures data immutability, and improves asset visibility for buyers. Through the integration of smart contracts and IPFS for doc- ument storage, the proposed system aims to enhance security, transparency, and efficiency in asset transfers. By enabling direct buyer-seller interactions and implementing a consensus mechanism for verification, this approach mitigates the risks associated with document tampering and unauthorized owner-ship changes. In summary, this research project acknowledgesthe limitations of the current approach in asset management and proposes a blockchain-based solution to overcome these challenges. By eliminating intermediaries, improving trans- action speed, ensuring data integrity, and enhancing asset visibility, this approach seeks to revolutionize the asset transfer process for the benefit of all stakeholders involved.

Fig. 1. Block Diagram of the proposed system

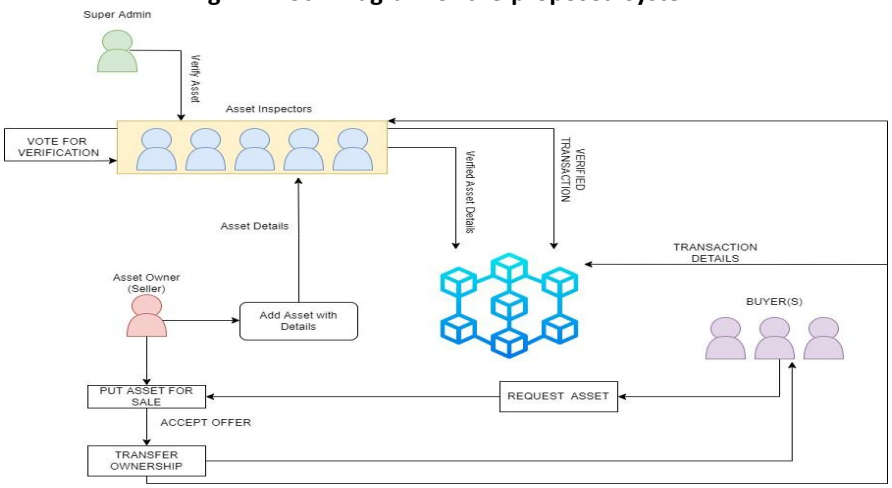
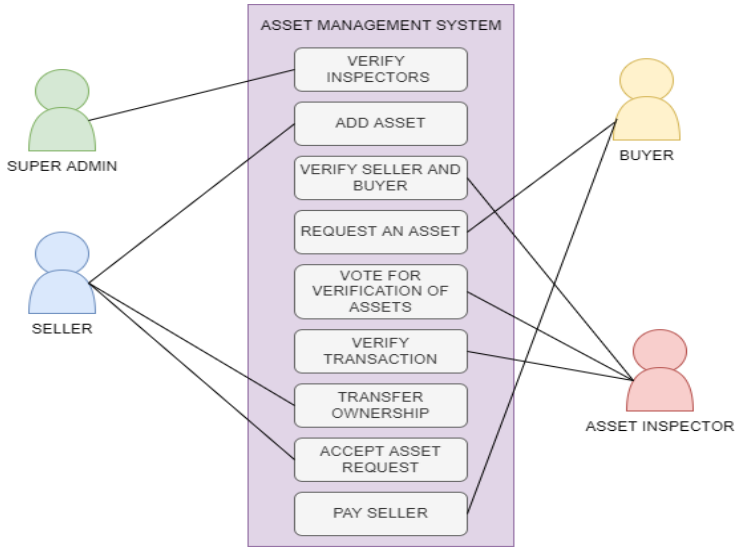


Fig. 2. Use Case diagram of the proposed system



V. Proposed Methodology

This research project has identified four potential roles necessary for the functioning of this asset management web application, namely:

1) Super Admin
2) Inspectors
3) Asset Owner or Sellers
4) Buyers

A. Super Admin Registration

The implementation of this proposed asset management web application employs an Ethereum blockchain backend. Initially, a smart contract was deployed on the Ganache framework for testing purposes. During this deployment, the associated address for the super admin is automatically set as the address on which the contract is deployed. The super admin's role is solely to verify registered asset inspectors. Upon accessing the application, the super admin is immedi- ately redirected to the admin dashboard.

B. Buyer/Seller/Inspector Registration

To ensure a user-friendly and comprehensive application, the system requires new users to have a Metamask account.

The application automatically detects whether the user is already registered or not. Users are prompted to select their role as a buyer, seller, or asset inspector. Upon selection,users are requested to fill role-specific details, which are then stored on the blockchain. A small gas fee is deducted from their Metamask wallet upon successful registration, and users are redirected to their respective buyer, seller, or inspector dashboard. Sellers or Asset Owner can add assets to the application, View/Accept/Reject asset requests and Transfer Ownership of an asset. Buyers can View and Request an asset from sellers and Pay sellers to transfer ownership ofan asset. Inspectors are responsible for verifying Buyer and Seller accounts, verifying assets added by sellers and verifying transaction between buyers and sellers.

C. Verify Asset Inspector

The super admin's responsibility is to verify the registered asset inspectors. Verification is based on the details entered byusers at the time of Inspector Registration and the uploaded Aadhaar document. The admin can view the uploaded docu- ment stored on IPFS and has the option to either verify or reject the inspector.

D. Verification of Buyer and Seller

Asset inspectors are tasked with verifying the registering buyers and sellers. Similar to the verification of inspectors, buyers and sellers are

verified by inspecting their Aadhaar documents uploaded by them. Asset inspectors have the option to either verify or reject the buyers and sellers.

E. Adding Assets (via Seller)

Registered sellers on the web application, who are the owners of assets, can add their assets to the application by filling out a form. The form includes the basic asset details, asset type, estimated selling price, images of the assets, and an asset-related document.

F. Verify Asset

Assets registered on the application by verified sellers need to be approved by all verified inspectors. Inspectors vote for or against the verification of the assets after reviewing the asset images and related documents. The application collects all the votes and verifies the asset only if it receives at least 50 percent of votes in favor of verification. Upon verification, the asset details are added to the blockchain.

G. Request for Asset

Verified assets are visible on the application to potential buyers. Buyers can request a specific asset by viewing its details. The request is then sent to the seller/owner of theasset, and upon approval by the seller, the transaction process begins. The buyer is required to purchase the asset using their linked Metamask account. This triggers a notification to the inspectors, allowing them to approve the transaction. After the transaction is approved, the new asset owner can view the asset in their owned asset section.

H. Approval of Request and Paying for the Asset

The owner of the asset receives the request for the transfer of the asset and verifies and accepts it if desired. Once accepted, the buyer must make the payment for the asset using their Metamask account. The amount in Ether (ETH) is debited from the buyer's account and credited to the seller's account.

I. Approval of Transaction of Asset

To ensure the validity of the ownership transfer and trans- action, an inspector is responsible for verifying the transfer. Once approved, the ownership of the asset is transferred to the new owner, and the previous seller is no longer the owner.

J. Editing Profile of Seller and Buyer

Buyers and sellers have the option to edit their profiles. The profile editing functionality is accessible through the respective dashboards of buyers and sellers. Only buyers and sellers have permission to edit their profiles, while inspectors do not require any intervention in the editing process.

VI. RESULT

The asset management web application is composed of a Super Admin, which is assigned on the basis of the wallet ad- dress of the user deploying the smart contract to the Ethereum blockchain network.

Users can register on the web application as a Buyer, Seller or Inspector by filling the respective form as shown in figure.3

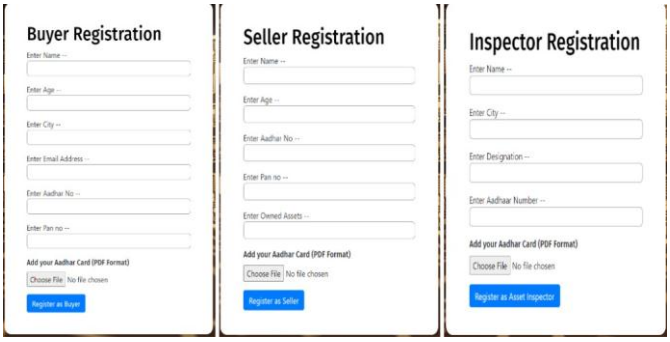


Fig. 3. Buyer, Seller, and Inspector Registration Forms (Left-to-Right)

Following successful registration a small gas fee is deductedfrom their metamask wallet and the user is redirected to either buyer, seller, or inspector dashboard respectively as seen in figures 4, 5 and 6 respectively. The buyers and sellers have an option to edit their profile. This can be done in the edit profile page present on their respective dashboards. The profile can be edited by only the sellers and buyers and not inspectors. No intervention of any other role is needed during the edit

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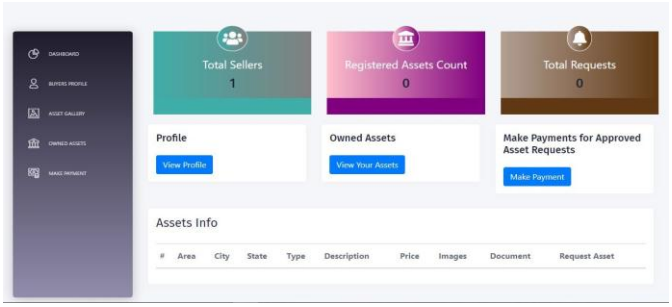

Fig. 4. Buyer Dashboard

The super admin's only task is to verify the registering asset inspector. The admin can view the details entered by inspectors as well as Aadhar documents which are stored using IPFS and has an option to either verify or reject the inspector as shown in figure 7

One of the functions of asset inspector's is to verify the reg- istering buyers and sellers. Similar to verification of inspectors,

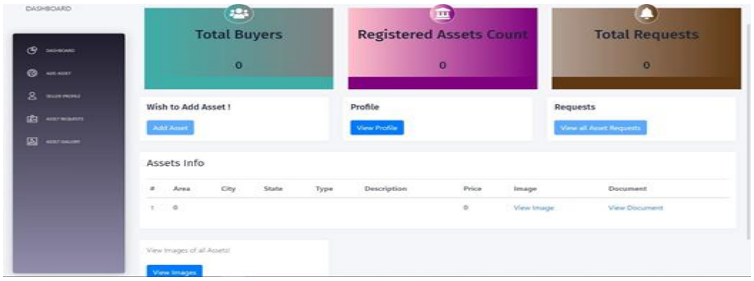

Fig. 5. Seller Dashboard

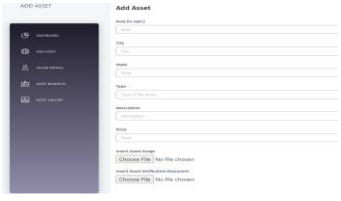

Fig.6.InspectorDashboard

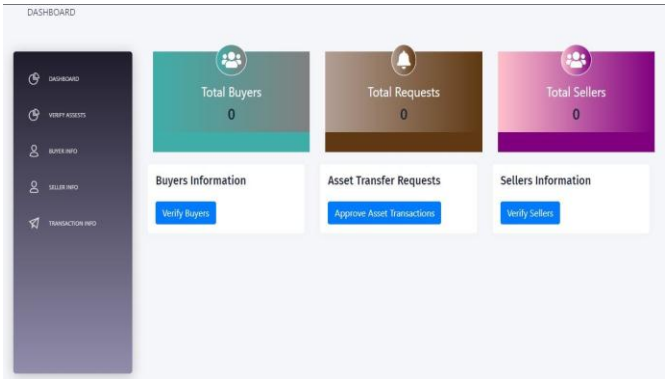

Fig. 7. Verification of Asset Inspector by Admin

the buyers and sellers are verified by inspecting their aadhaar documents uploaded by them. The asset inspectors have an option of either verification or rejection.

The owners of assets, registered as sellers on the webapplication can get their assets registered on the application byfilling out a form as shown in figure 8 which includes details such as the type of asset, the estimated selling price of the asset, images of the assets and an asset verification document. The assets once registered on the application by a verified seller need to be approved by all the verified inspectors. Theinspectors vote for or against the verification of the assets. Theinspectors can view the asset's image and related documents. The application gathers all the votes for the asset, for and against. The asset is verified only after receiving 50 percent of votes in favor of the verification. Once verified the asset details are added to the blockchain.

Fig. 8. Add Asset Form

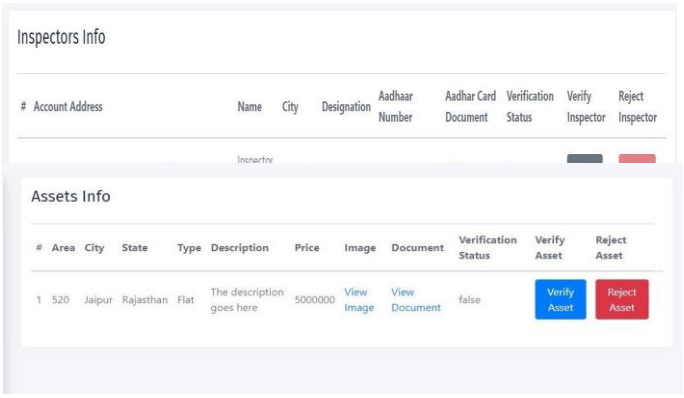

Fig. 9. Verification of Asset by Inspector

The verified assets are visible on the application to all potential users. The buyers have the option to request the asset.The asset details can be viewed by the buyer. The notification is sent to the seller i.e.

owner of the asset. Once approved,the transaction begins. The buyer is supposed to buy the asset using the linked Metamask account. This sets up a notification to the inspectors allowing them to approve the transaction. After this, the new asset owner i.e. can view the asset in its owned asset section.

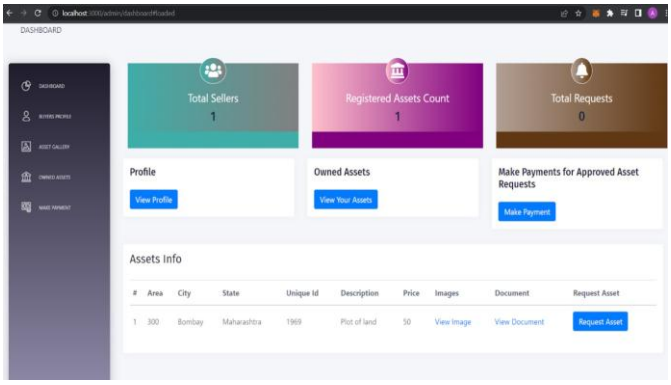

Fig. 10. Request asset available for sale

The owner of the asset receives the request for transfer of the asset. The owner can then verify this request and accept it. Once accepted, the buyer has to then pay for the asset using their metamask account. The amount in ETH is debited from the buyer's account and credited to the seller's account.

Fig. 11. Paying for the asset

In conclusion, this project contributes to the advancement of decentralized asset management systems by providing a practical implementation of a web application that enables direct buyer-seller interactions. The utilization of blockchain technology, smart contracts, and IPFS ensures the security, transparency, and efficiency of asset transactions. Future re- search can focus on scalability and further enhancements to improve user experience and expand the application's capabil-ities.

The ownership transfer and transaction are supposed to be verified by an inspector. The transfer once approved changes the owner of the new asset and the seller is no longer the owner of the new asset.

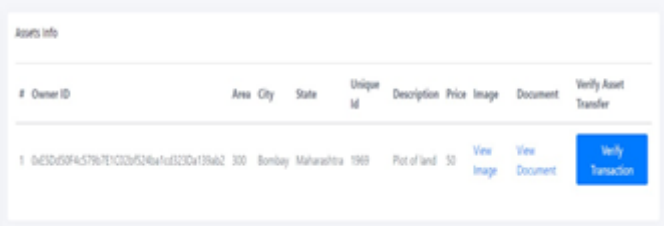

Fig. 12. Approve transfer of asset by inspector

VII. CONCLUSION

The results obtained from this project demonstrate the suc- cessful implementation of a decentralized asset management web application. The web application provides a platform for buyers and sellers to engage in asset transactions without the need for intermediaries such as brokers or government employees. The use of blockchain technology and the IPFS for document storage ensures increased security, decentralization of the system, reduced costs, minimize delays, provide more timely and accurate data, and enhance reporting accuracy.

Through the developed web application, buyers and sellers can register, verify their identities, and add assets for sale. The verification process involves multiple inspectors, and the con- sensus mechanism ensures the prevention of corrupt inspectors influencing the verification outcome. The verification process provides transparency and reliability in determining the au- thenticity of assets. The asset management web application enables buyers to view verified assets and make requests for asset purchases. The transaction process is facilitated through smart contracts and the integration of Metamask for secure and efficient payments. The involvement of inspectors in approving transactions further enhances the integrity of asset transfers. The successful completion of this project highlights the po- tential of blockchain technology in revolutionizing traditional asset management systems. By eliminating intermediaries and relying on decentralized consensus mechanisms, the web application offers a more efficient, transparent, and secure platform for asset transactions. The use of IPFS for document storage enhances data integrity and makes it more difficult for malicious actors to compromise the system.

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