ASSET MANAGEMENT SYSTEM USING BLOCKCHAIN

A major project report submitted in partial fulfillment of the requirement for the award of degree of

Bachelor of Technology

in

Computer Science & Engineering / Information Technology

Submitted by

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled "Asset Management using Blockchain" in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and submitted to the Department of Computer Science & Engineering And Information Technology, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by "Avinash Thakur (201388) and Satyam(201170)" during the period from January 2024 to May 2024 under the supervision of Dr. Amit Kumar, Department of Computer Science and Engineering, Jaypee University of Information Technology,Waknaghat.

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Candidate's Declaration

I hereby declare that the work presented in this report entitled **'Asset Management System Using Blockchain'** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering / Information Technology** submitted in the Department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology, Waknaghat is an authentic record of my own work carried out over a period from January 2024 to May 2024 under the supervision of **Dr. Amit Kumar** (Assistant Professor(SG), Department of Computer Science & Engineering and Information Technology).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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(Supervisor Signature with Date)

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List of Abbreviations

Abbreviation	Name
ABAC	Attribute-based access control
API	Application programming interface
GUI	Graphical User Interface
IDE	Integrated Development Environment
IOT	Internet Of Things
IPFS	Interplanetary File System
JSON	JavaScript Object Notation.
SOL	Solidity
TPS	Test Procedure Specification
VS	Visual Studio
TPS	Test Procedure Specification

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ABSTRACT

Building a Block chain Asset Management System for the Disabled Persons' Education Association. Transparency and security are some of the common challenges in conventional asset management systems. To this end, we have provided a new approach that incorporates the use of the blockchain technology. By using a blockchain leger, we are able to record and authenticate asset transactions, thereby creating an unmoved record of asset ownership and actions that cannot be tampered with. We introduce smart contracts into the whole system in order to fully automate predefined rules on the control over assets during the transfer, maintenance, and auditing which leads to a decrease in the total number of steps involved and reduces the probability for mistakes and frauds. So our key features are real Blockchain being decentralised does eliminate the need for central authority building up trust in stakeholder and reducing possibility of dispute. Conversely, we deal with scalability, interoperability, and integrating the system with current infrastructure so as to achieve operational viability and ease of implementation Subsequently, we constructed and evaluated the prototype using a virtual setting. The findings suggest increased effectiveness, better governance, and improved security over conventional assets management systems. By using a blockchain leger, we are able to record and authenticate asset transactions, thereby creating an unmoved record of asset ownership and actions that cannot be tampered with. We introduce smart contracts into the whole system in order to fully automate predefined rules on the control over assets during the transfer, maintenance, and auditing which leads to a decrease in the total number of steps involved and reduces the probability for mistakes and frauds. We can conclude that the realization of this blockchain based asset management approach is a bold step forward towards improved operational efficiency. This finding adds to the growing body of knowledge on real world use of blockchains, providing valuable information to organisations wishing to improve asset management by means of a unique, simple, safe tool.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Blockchain technology has revolutionized industries promising higher levels of transparency, security, and efficiencies. This project examines how blockchain can be used in asset management with the aim of modernizing asset track, trade, and manage processes. The distributed digital ledger records every transaction, time-stamps it, and forms an irreducible chain of custody, thereby tracking asset ownerships and movements in an open and secure manner. This increases the transparency of the assets data, which in turn reduces the possible inconsistencies and builds the trustworthiness of the assets data. The technology ensures that data is safe and cannot be altered through the use of cryptographic techniques. Smart contracts are important in eliminating the need for third-parties and hence, reduced fraud risks and unauthorized modifications. Moreover, smart contracts also help in automation of asset management processes. It undertakes tasks like asset transfer, maintenance, and auditing without delays and errors. In addition, this simplifies operations and ensures that transactional processes are based on given rules. Blockchain eliminates brokers and smart contracts and prevent fraud in asset trading. Blockchain is transparent and enables one to confirm in real time the ownership and authenticity of assets. Block chain also allows fraction owning, whereby an investor gets a share of a high valued commodity. Blockchain has also been instrumental in removing territorial barriers that hindered access to asset markets. This broadens and widens participation to more stakeholders. It is possible to track assets in real time, which gives an instant and precise data about state and place of the asset. In summary, integrating blockchain in asset management is a revolutionary step towards improved asset management. improved transparency, security, and efficiency. In essence, blockchain technology integrates and eliminates the services of intermediaries, automates processes with smart contracts, and ensures worldwide accessibility for asset management and trading, thereby redefining how assets are managed and traded. The project seeks to highlight the various benefits of adopting blockchain in the management of assets. We look towards the future where the complex benefits of integrating blockchain technology go beyond just short-term improvements. However, the project's effects transcend mere cost cuts, as it heralds in a new perception of what assets are, their valuation, and marketplace relations. Trustworthiness is important for asset management practice to evolve. Transparency, security and reliability that come with blockchain are key factors for building up trust among stakeholders. The project demonstrates this by highlighting how it contributes to the robustness of financial systems while advocating for the role of all stakeholders in the management and trade of assets. This paper delves into how the potential of blockchain can be used to tackle current asset management issues and pave the way for an egalitarian financial system tomorrow.

1.2 PROBLEM STATEMENT

Project addresses crucial deficiencies of typical asset management systems. These include widespread lack of transparency which keeps stakeholders in darkness on what is happening to their assets. Such opacity can be highly detrimental to the effectiveness and promptness of decision-making processes. In a bid to rectify this, the project utilizes blockchain, incorporating a distributed journal that guarantees immutable and transparent records of all assets' transactions. Traditional systems for managing assets have experienced security issues such as tampering and data breaches, which have hindered their efficiency. This initiative seeks to provide relevant stakeholders real-time and reliable data that can help them make informed decisions regarding asset allocation. This concern is addressed through the use of strong security built into blockchain's cryptographic technologies. The ledger keeps track of each transaction and ensures that all transactions are secure due to the robust architectural structure that makes it very difficult for anyone to gain unauthorized access. It builds trust with shareholders, while also adding security to the asset's confidential details or information. Traditional asset management, by way of intermediaries, has been proven to compromise efficiency. Smart contract integration intends to make these practices simpler; for example, some of them are asset transfer, maintenance, and auditing . The system becomes more efficient because it eliminates intermediaries and the delays and potential errors that may stem from manual intervention.

The traditional asset management field is highly complex and relies on third-party intermediaries, which make it vulnerable to fraud. This risk of failure is greatly reduced through blockchain's transparency and real-time verification mechanisms. The stakeholders may be able to verify that the asset's ownership is genuine and that the transactions have taken place correctly in real-time. This will drastically reduce fraudulent activity and enhance system integrity. Additionally, the project seeks to revamp the core meaning of assets management. It incorporates blockchain to change how we track, administrate or trade assets as we have always known them. By integrating blockchain, it transforms the conventional norms of tracking, managing, and trading assets. It includes the blockchain which makes it a different way of tracking, managing, and trading assets. The transparent and distributed characteristics of blockchain break geographical boundaries, enabling global involvement in the asset trading process. Instead, they propose a new definition of asset management that is designed to address those challenges in addition to revolutionizing the industry and establishing the ground for a new and more equitable, safe, and effective asset management paradigm.

1.3 OBJECTIVES

This project has multiple objectives geared to addressing critical issues in conventional asset management through the application of blockchain. These objectives include:

ENHANCE TRANSPARENCY:

- Make use of blockchain to offer instant information on asset condition, ownership, and provenance.
- Avoiding any variations by making an incorruptible and transparent document easily available for the concerned parties on asset ownership and transfers.

IMPROVE SECURITY MEASURES:

- Make use of built in cryptographic algorithms in blockchain to strengthen the integrity and resist tampering on asset data.
- Use the decentralized blockchain to mitigate the risk of unauthorized access and data breaches.

STREAMLINE ASSET MANAGEMENT PROCESSES:

• Use smart contracts to automate the crucial asset management operations like transfer, maintenance, and audit.

• Reduce delays and eliminate possible errors, which may arise due to intermediaries during assets transaction.

REDUCE FRAUD RISKS:

• Use transparency in blockchain to verify asset ownership in real time thereby reducing cases of fraud.

• Ensuing an environment of trust for the trading of assets through verifying the legality of the transactions.

REDEFINE ASSET TRACKING AND TRADING:

• In this regard, bring a paradigm change to how asset will be monitored, managed and transacted through the abilities of blockchain.

• Make all asset markets internationally accessible by overcoming border and enhance inclusivity in asset ownership.

CONTRIBUTE TO A MORE INCLUSIVE FINANCIAL LANDSCAPE:

• Allow for fractional ownership via blockchain so that more investors can buy into high value assets.

• Enables global access to asset markets facilitating inclusiveness and diversity of participation in financial systems.

VALIDATE THE EFFECTIVENESS OF BLOCKCHAIN INTEGRATION:

• Design and implement a prototype in a simulated environment to verify that blockchain integration brought efficiency, improved transparency and security.

• Evaluate the scalability and practicability of the outlined blockchain-based asset management system.

Achieving these goals is aimed at proving the transformative capacity of bitcoin as a disruptive factor for the outdated asset management systems that are considered to be insecure, untransparent and inefficient by the contemporary standards.

1.4 MOTIVATION AND SIGNIFICANCE OF THIS PROJECT

The motivation behind this project stems from the recognition of critical limitations in traditional asset management systems and the transformative potential offered by blockchain technology. Traditional systems often grapple with issues of transparency, security vulnerabilities, operational inefficiencies, and the persistent risk of fraud. The motivation to harness blockchain technology arises from its promise to address these challenges comprehensively. The significance of this project lies in its potential to redefine how assets are tracked, managed, and traded. By leveraging blockchain, the project introduces a decentralized ledger that ensures real-time visibility, transparency, and immutability in asset transactions. This shift not only mitigates existing challenges but also sets the stage for a more resilient and inclusive financial landscape.The significance is further underscored by the enhanced security measures brought about by blockchain's cryptographic techniques. The implementation of smart contracts automates key asset management processes, reducing the need for intermediaries and streamlining operations. The elimination of intermediaries not only reduces costs but also minimizes the risk of fraud and unauthorized alterations in asset transactions. The project's significance extends to fostering inclusivity through fractional ownership and global access. Blockchain enables investors to own a portion of high-value assets, making asset markets more accessible and diverse. The decentralized nature of blockchain breaks down geographical barriers, allowing a broader range of stakeholders to participate in asset management. In essence, the motivation and significance of this project lie in its potential to revolutionize traditional asset management practices. By embracing blockchain technology, the project aims to contribute to improved transparency, security, and efficiency in asset management, paving the way for a more resilient, secure, and inclusive financial future.

1.5 METHODOLOGY

In regards to its methodology, the process of blockchain involves creating a genesis block, Block 1, Block 2, and so forth. The first block in the chain, genesis block, is hand-created, setting the basis and including data such as a timestamp and a signature. A blockchain comprises various blocks, each of which has a headline consisting of metadata such as a time stamp, the reference to the previous block excluding genesis block, and a hash value. Miners or validators compete to be the ones that will solve a cryptographic puzzle for appending the new block to the blockchain as users submit transactions for inclusion in a block. Consensus provides for the confirmation by nodes of the legitimacy of the proposed block before it can be added to the chain. Each link block references the previous block in order to construct a chain of blocks that ensures chronological ordering and the immutability of transactions. The blockchain is maintained by a set of distributed nodes, leading to decentralisation, and it is an ongoing process that repeats when adding the next block to the sequence.

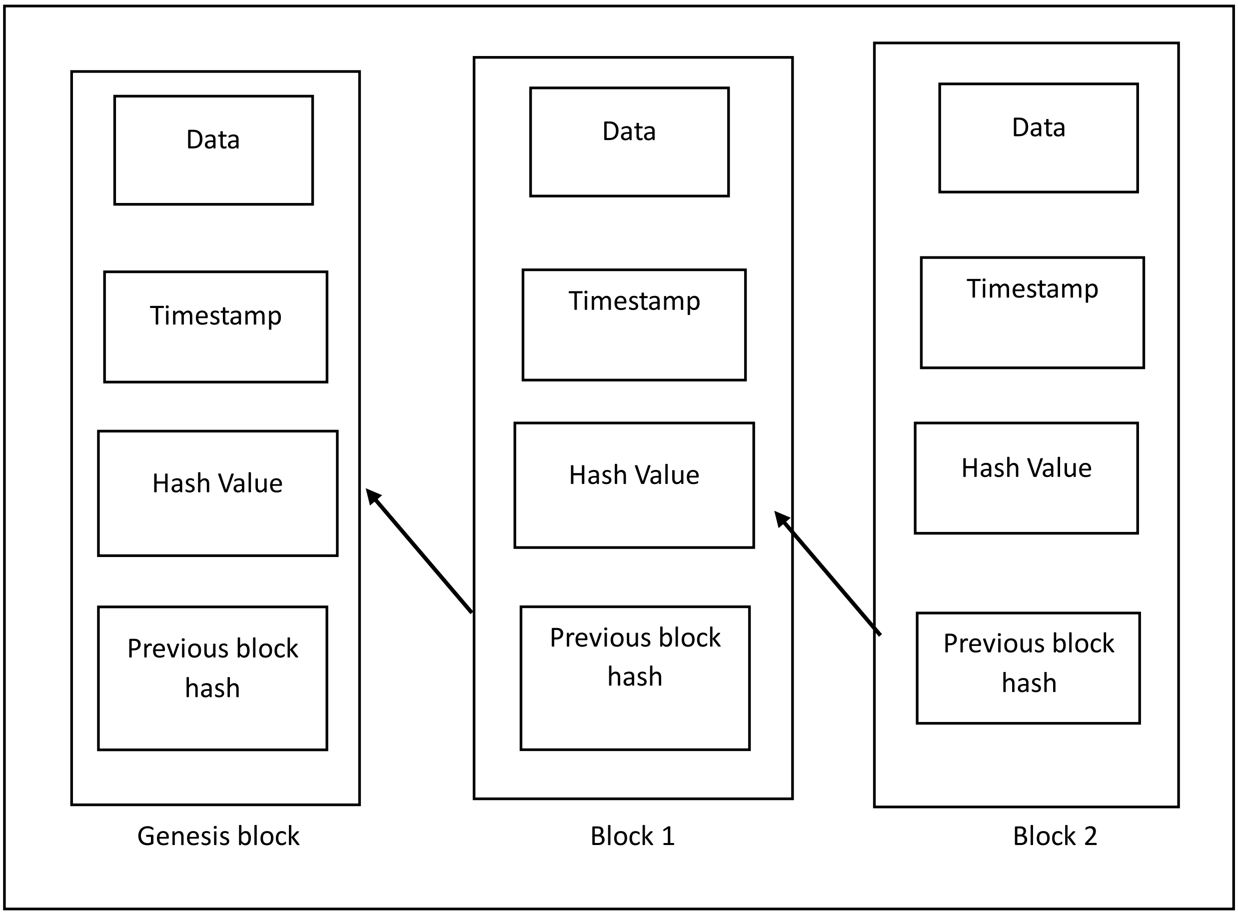

Fig 1. Block Diagram of our Methodology

The blockchain is built progressively, with each block in a continuous chain referring to the previous one. For instance, the security of blockchain relies on cryptographic hashing and consensus mechanisms to provide computationally impossible tampering. This is a transparent and secure way to keep track of transactions in an untrusted world.Ganache, a test network of a local test network has been set up for development and testing before it can be deployed on the main Ethereum network.The essential prerequisites for running this project include Curl, Git, Node.js, Npm, Truffle, and Ganache.

Workflow comprises the initiation of a project on Truffle HD Wallet Prover website with generation of a key and its storage in smart contract for asset tracker. A custom RPC “Ganache” with the URL for ganache RPC points to MetaMask, as a digital wallet. The importation of the accounts from Ganache to MetaMask leads to the definition of the six different players’ accounts in MetaMask which are owner, manufacturer, stockholder, wholesale, retailer, and consumer. The recipient’s address, the UUID, and the sender’s account in MetaMask are specified for starting asset transfers. The asset is considered transferred upon confirmation in the MetaMask pop-up and a successful gas deduction.The products are created through the first account associated in a contract and viewing the asset ID allows one to view its history of transfers with timestamps. ‘Now’ is a keyword in the contract to help register assets and computing the time and date of transfer.

Dapp created based from HTML pages, JavaScript on the browser side, web3.js library, and Ethereum blockchain centred with authority control and tracking as main focus. Users can trace the location of a product using this feature. A transaction is when a buyer buys a product from a seller under agreements and thereafter transfer by a selected service provider. The product comes with certain agreements that constitutes a set of rules. The system adopts a distributed model, allowing an improvement in the front end logical procedures that can help in issues of scalability.

CHAPTER 02: LITERATURE SURVEY

2.1 OVERVIEW OF RELEVANT LITREATURE

It uses the blockchain technology in asset tracking to ensure that the products are not tampered with. Individual identifiers and packaging are equipped for each product depending on its nature for the purpose of continuous traceability along the supply chain. Asset tracking systems are mainly used to strictly track the products journey by confirming that it is original and where any possible manipulation has taken place. decentralized Blockchain technology approach ascertains that the buyers don't need merchants to confirm the authenticity. The paper involves a Blockchain distributed system comprising anti-counterfeit attributes by which manufactures can supply original items without owning a direct-operated store. Thus, this innovation is a prospect for decrease in the expenses related to the product quality assurance. A number of recommended technologies for detection of false products in supply chain can be used by customers. Customers can scan QR codes that are affixed on the products. The information about transaction history and current ownership will help in assessing the authenticity of a product. The basic approach about asset tracking systems using blockchain [1] explains the fundamentals and impacts of the technology on monitoring asset This principle focuses on decentralization, transparency, efficiency, and real time monitoring. This elimination of intermediaries creates a direct tamper-proof ledger, where trust and accountability of assets tracking is guaranteed. Further, the research on secured transactions over blockchain [2] further the discussion to the secured executions of transactions. The research employs cryptographic techniques, decentralized consensus mechanisms, and smart contracts to enhance transaction security. Secondly, focusing on the education domain, we introduce the Educational Digital Assets Management System. Thirdly, provides a transparent, secure and efficient management of education resources. In terms of real-time tracking, secure distribution, and immutable academic records, educational materials management signals a paradigmatic shift, increasing credibility and global accessibility. The revolution that can be achieved through automation and transparency in assets management within the business processes as a means of executing processes and assets' management presents great promise. By utilizing real-time inventory monitoring, smart contracts, and secure identity verification, one can come up with an accountable and reliable system. This model encompasses a transparent and technological system of distribution of rations, which have traditionally been distributed through bureaucratic procedures. [1] The management of digital identities is also taken up in this global aspect of asset management across boundaries. Private and permission blockchain use for enhancing security and traceability during passport and visa related transactions with a focus on privacy and permission control. This research investigates how blockchain can assist in building a better and safer financial system.

To sum up, the combination of these varied projects points out the widespread power of Blockchain technology. Asset tracking, secure transactions, educational asset management, business process optimization, ration distribution, global collaboration, digital identity management, and financial asset optimization are based on shared elements like transparency, security, and efficiency. Together, these studies provide an overarching narrative on how blockchain can completely disrupt traditional paradigms and transform various business and social sectors.

Asset Tracking Systems Using Blockchain [1]

This work explores the use of block technologies to improve asset-tracking systems. According to the study, it seeks to decentralize the ledger with a view of enhancing transparency, efficiency, and live tracking in asset movements. It is based on a decentralized approach that does not require intermediaries but direct access to immutable records of asset movements. This leads to a tamper proof and transparent ledger which results to trust and accountability of asset tracking while at the same time disrupts traditional systems.

Secure Asset Transaction Using Blockchain [2]

The discussion on this research further covers secure assets' transactions and how blockchain is involved in the process. Transaction security is ensured by cryptographic techniques, decentralized consensus mechanisms and smart contracts as the main components. These functions would develop a transparent and secure environment, reduce fraud and create confidence with asset transactions. However, these are not the only impacts they create but are an addition that contributes towards integrity in asset management systems.

Blockchain-Based Educational Digital Assets Management System [3]

This study is an introduction of a blockchain-based system for management of digital assets in the educational domain. Transparency, security, efficiency, real-time tracking, safe distribution, and non-manipulative academic records are stressed out here. This represents a new way of managing educational materials, promoting trustworthiness and global availability. Application of blockchain technology in education can revolutionize management and distribution of educational assets.

A Model-Driven Engineering Tool for Blockchain-Based Business Process Execution and Asset Management [4]

This paper presents a Model-Driven engineering tool for processes and asset management on the blockchain. They include emphasizing automation and transparency in different business processes which can revolutionize organizations' process execution and asset management. Applications of this tool goes beyond certain sectors with the sole aim of improving efficiency and transparency in many fields/sectors.

A Design Framework for Smart Ration Shop Using Blockchain and IoT Technologies [5]

This study puts forward a design framework for ration distribution based on blockchain and IoT technologies. This framework will ensure improved accountability, security, and efficiency. Key elements include real-time inventory monitoring, smart contracts, and secure identity verification that makes the system robust and reliable. However, this framework tackles the problems with conventional ratio distribution mechanisms, offering a high tech and transparent means of distributing vital commodities.

Towards Global Asset Management in Blockchain Systems [6]

Taking the scope worldwide, the present research considers global asset management utilizing blockchain systems. Smart contracts underpayment highlights a decentralized approach to global access, increased transparency, low fraud incidences, and high efficiency. This worldwide approach represents a joint and encompassing way of asset management, which overcomes the barriers between countries in regard to managing global assets.

Digital Passport and Visa Asset Management Using Private and Permissioned Blockchain [7]

The paper extends blockchain technology to the field of digital identity by focusing on passport and visa transactions. This study explores the use of private and permissioned blockchains to enhance security and traceability of such transactions with consideration of privacy and permission control. The use of blockchain in managing digital identities provides a glimpse into how it can address security and privacy issues in identity transactions.

Optimizing the Core Business Processes of Financial Asset Management Companies Using Blockchain Technology [8]

This study addresses the optimization of the core business processes in financial asset management companies in the financial sector through blockchain technology. This emphasizes efficiency, cost reduction and increased transparency. It is a case of a study on how blockchain can enhance a more effective and safe financial system. The discussion on blockchain as a game changer extends beyond financial assets optimization to the broader discussion on its transformational potential in financial services.

Finally, the amalgamation of different studies shows how all-encompassing is influence of blockchain on various industries. Asset tracking, secure transactions, educational asset management, business processes, ration distribution, global collaboration, digital identity management, and financial asset optimization all have common threads of transparency, security, and efficiency. Each study has its own viewpoint and provides valuable insights into how blockchain has the potential to transform various markets and change the current thinking. This overview is basically the introduction that serves as the foundation for better understanding the multi-faceted impacts of blockchain technology in different industries as it pertains to the future of those industries.

TABLE 2.1

Methods	Advantages	Journal Year	Disadvantages
Asset tracking systems using blockchain [1]	Enhanced transparency, Real time tracking.	2022	Possible bias, outdated info, complex language,
Secure asset transaction using blockchain [2]	Enhanced security through cryptographic techniques, use of smart contracts .	2022	It doesn't eliminate brokers, scalability issues, high computing power.
Blockchain-based Educational Digital Assets Management System [3]	Streamlined Asset Distribution, Cost Savings and Efficiency	2021	Integration Issues, scalability issues , regulatory concerns.
A Model-Driven Engineering Tool for Blockchain-Based Business Process Execution and Asset Management[4]	Solidity smart contracts for asset registries and a blockchain trigger for smooth integration	2021	It has potential challenges and risks information on its performance
A Design Framework for Smart Ration Shop Using Blockchain and IoT Technologies [5]	Automated Smart Contracts, Data Integrity and Traceability	2020	Small sample, potential researcher bias, short timeframe.

Towards Global Asset Management in Blockchain Systems [6]	Decentralization for Global Access , Reduced Fraud and Increased Security	2019	Global asset system hindered by slow processing.
Digital Passport and Visa Asset Management Using Private and Permissioned Blockchain[7]	Immutable Recordkeeping , Enhanced security	2019	Integration Issues, scalability issues , regulatory concerns.
Optimizing the core business processes of financial asset management companies using blockchain technology [8]	Streamlined Asset Distribution, Solidity smart contracts	2017	Study limitations: small sample, potential researcher bias, short timeframe;

2.2 KEY GAPS IN THE LITREATURE

1. The scarcity of research on specialized utilities of blockchain based asset management systems for industry.

2. Inadequate coverage of the scalability issues and scalable asset management measures.

3. Insufficient study of the blockchain asset management system implementation problems encountered in the real world.

4. The absence of an in-depth assessment of security vulnerabilities and counter measures in asset management smart contracts.

5. Insufficient examinations of integration and interoperability problems in relation to the existing systems.

6. The lack of thorough knowledge on user experience design principles and the variables affecting the use of software in organizations.

7. A lack of consideration regarding the long-term sustainability and maintenance aspects of blockchain based asset management systems.

8. Regulatory examination and compliance gap for blockchain asset management.

9. Privacy concerns and data protection are still largely unexplored in blockchain based asset management.

10. The deficiency of quantitative performance indicators for evaluating blockchain assets management frameworks.

11. Smarts contracts testing and auditing best practice gap in asset management system.

12. Lack of investigation into proper incentive schemes for network members in blockchain-driven asset management.

CHAPTER 03: SYSTEM DEVELOPMENT

3.1 Requirements and Analysis

For the creation of an asset management system utilizing blockchain, a thorough analysis of requirements is required to enable the functioning, security, and user interface of the system. The system's functionality should include reliable asset tracking with the use of real-time updates and smart contracts for automated operations like transfer and maintenance. User roles and access to reports should be clearly defined for adequate operation. Data encryption, tight access control, identity verification procedures, and smart contract security audit should form the basis of security requirements. Usability is focused on developing easy-to-use user interfaces, including user training and accessibility. The interoperability considerations include having no problems connecting with the current systems and selecting a blockchain platform based on compatibility criteria. Scalability planning, regulatory compliance and cost considerations are among the important aspects that should be considered, thoroughly.[2] It includes comprehensive documentation such as user manuals and technical documentation and the provision of exhaustive testing processes which cover the security auditing and various testing stages. User training programs and customer support mechanisms make sure users get through easily, hence, an initial success and sustainability.

Analysis of the essential points in creating a blockchain based asset management system. The system will be tracking assets in a real time mode using smart contracts for automation purposes as well as providing simple reports. Data encryption, access controls, and smart contract security are some of the security measures. Usability deals with the intuitive interface and user training, but the system should provide real time tracking of assets, smart contract automation. These include scalability planning, regulatory compliance, and cost considerations. These include stringent documentation and testing policies that guarantee to build strong systems. User experience is improved through training programs and customer support. Essentials in the creation of a blockchain based asset management system.[3] Real time monitoring assets via smart contract based automated system and the ease of reporting. These security measures include data encryption, access controls, and smart contract security. This relates to intuitive interface and the user training in usability.

3.1.1 FUNCTIONAL REQUIREMENTS

Certainly! The functional requirements of a blockchain based asset management system provide an outline of the functions and capabilities that it has to have to meet its objectives. Here's an explanation of each functional requirement:

User Authentication and Authorization:

Explanation: This entails developing a secure and robust identification system that allows only authentic persons to get access into an asset management system. Authorization mechanisms control access to system functions and the actions that can be undertaken by different user roles, ensuring security and data integrity.

Asset Creation and Registration:

Explanation: The ability to create as well as register new assets is one of the unique features of this tool.[6] The blockchain is used to record relevant information about assets, including asset details, ownership, and unique identifiers during the process of asset creation. This creates impartial evidence of ownership of each asset.

Asset Tracking:

Explanation: It is the ongoing process of documenting an asset's movements, including changes in ownership. Blockchain's ledger that is distributed across all the parties helps users to track down all the way up to the asset's origin, all the people who owned it, and all the transactions it was involved in.

Ownership Transfer:

Explanation: This helps ensure smooth transfers of asset's ownerships in the blockchain. Smart contracts help to transfer ownership automatically after predetermined conditions.[11] This ensures security and reliability in the process. This is a necessary component of keeping an accurate and up-to-date list of owning asset.

3.1.2 NON-FUNCTIONAL REQUIREMENTS

Certainly! Non-functional requirements state how the system ought to respond or behave, as opposed to what the system should do. They deal with the critical characteristics which contribute to systems effectiveness. Here's an explanation of each non-functional requirement in the context of an asset management system using blockchain:

Performance:

Explanation: Performance of the system means how responsive and efficient it is in performing different tasks. The speed at which a system can process transactions, generate reports, or other critical aspects in the context of asset management through blockchain, among others. The effective performance guarantees less delays and latencies experienced by the users.

Scalability:

Explanation: Scalability refers to the capability of the system to manage an increase in the amount of data, number of users, or the number of transactions taking place, without affecting the performance. Scalability is an imperative element of the asset management system because it should be capable of handling increased numbers of assets, users, and transactions as time goes by, while at the same time, maintaining acceptable performance levels.

Reliability:

Explanation: Its reliability, meaning its consistent, error-free or downtime free performance, is what the system refers to. Reliability provides accuracy in recording of assets as well makes the system to be available for users whenever they need it for purposes of managing assets. Such reliability is of great importance while ensuring the credibility of the whole system.

Security:

Explanation: Blockchain-based system have to be very secure It is the process of safeguarding data, transactions, and access to the system from illegal users. Other security measures entail encryption, authentication, authorization, and smart contracts for making sure that only authorized persons will alter or access certain data.

Maintainability:

Explanation: Maintainability concerns the ease with which the system can be revised, updated and repaired. Maintainability is a crucial aspect of asset management, as it allows the system to remain intact during changes in the regulatory frame, business processes, or technological development, without any interruption involved. These entail having documented code, modular architecture, and easy updates.

In a nutshell, these non-operational requirements altogether constitute the performance, reliability, and safety of an asset management system based on blockchain technology. The maintain it in top shape, accommodate changes, make it safe, and improve users' experience.

3.2 PROJECT DESIGN AND ARCHITECTURE

A. User Interface Module

Integration of the User Interface (UI) module is essential as it provides users friendly and efficient experience to asset owners and manufacturers within the blockchain-based asset management system. [11]This module is the access port through which users check the status of their assets, while also serving as a platform for manufacturers to build and transport assets to other areas. A web-based tool in the form of multiple modules that allow for creation and transfers of assets as well as live monitoring.

Specifically, the Ethereum addresses issued to each individual user, mostly manufacturers, enhance the security and unique nature of the system. It also helps to authorize and control as each manufacturer can only have specific ability of creating assets.[22] To improve on the user visibility, there is the use of the map API in the asset search module to show the user the asset's coordinates. This aspect is important because it assists with ongoing tracking and accurate location and movement of assets.

The development of the web interface using React and web3.js enables users to interact easily with the blockchain. The dynamic web pages of the interface are developed by using React, a server-side scripting language. On the other hand, web3.js, a JavaScript library, provides the necessary means to integrate blocks into the web interface for seamless communication with the underneath blockchain network. Figure 2 shows the architecture of the proposed system, which demonstrates the complicated relationships between the involved users such as manufacturers, supply chain participant and buyers to blockchain.[4] It outlines the routes through which communication to the blockchain should be made by users with a GUI that enables users to update the asset's state. This architecture renders the system's structure and how the web interface is integrated with the blockchain backend transparent, accessible, and functional.

Architecture of the proposed system is presented in Figure 2 to represent complex relations existing among participants of supply chain, manufacturers and buyers to blockchain. It specifies the ways through which users with GUI should communicate to the blockchain and update the asset's state. The architecture makes the system structure as well as the integration of the web pages.

The proposed system architecture as shown in figure 2 illustrates the intricate relationships that exist amongst the participants of supply chain including the manufacturer and the buyer to the blockchain. It describes the protocols or procedures under which GUI users are expected to communicate to the blockchain as well as update the state of the asset. It is the structure of the system as well as the integration of the web in the system.

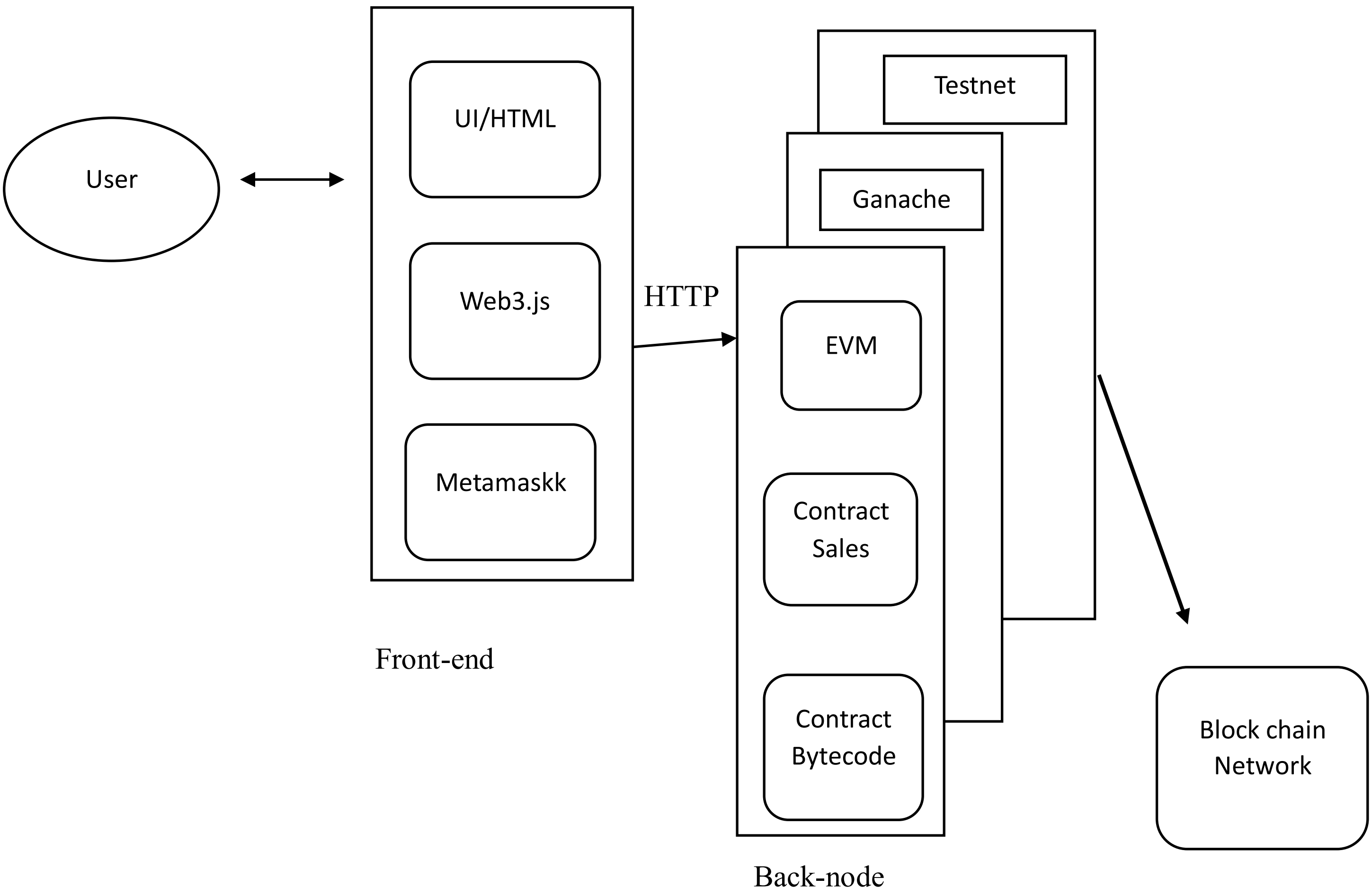

Fig. 2: Proposed Architecture

B. Smart Contracts Module

Essentially, Smart Contract Module acts as a basis for asset tracking capabilities of BAMS and builds it up on Solidity smart contracts. The smart contracts, which serve as digital agreements that run on code, automate key asset management processes such as product development, search, and transfers of ownership.[7] Smart contracts entail automated execution of pre-determined actions once the specified conditions contained in the contract have been satisfied. In this case, two critical contract files - AssetLibrary.sol and AssetTracker.sol - define and execute contract smarts. The AssetLibrary.sol file located inside the AssetLibrary.sol folder comprises Solidity codes containing common elements. This enables gas cost optimization while maximizing operational efficiency. Gas in the Ethereum network is a measure of the computational power needed in executing operations hence the need to optimize on gas. Asset Tracker.sol which can be found in the Asset Tracker.sol folder implements several important asset management functions. It involves the manufacture of assets, tracking them, recording their status and generation of authentication keys for safe usage. In the system, the modular approach makes sure that the defining of common functionalities is done in AssetLibrary.sol. Such separation of concerns results in less redundancy and gas wastefulness, making the smart contracts leaner.

What makes a smart contract powerful is that it tests conditions before executing the code running underneath. This guarantees that all the transactions and associated operations follow set rules and conditions ensuring that any asset related action is genuine and authentic. A validating condition is such that a smart contract will act as a self-executing and trustless mechanism thus eliminating third parties while increasing dependability on this asset management system.[19] Modular design is reflected in Assetlibrary.sol and assettracker.sol which increase gas cost efficiency, reduce duplication, and ensure the smooth running of the operation. It utilizes smart contracts that ensure that transactions are automated but follow certain predetermined terms, thus promoting a safe and clear manner of embedding asset operations within the blockchain network.

Key Components:

AssetLibrary.sol:

Purpose: Saves Gas from AssetTracker.sol by defining common code.

Functionality: Improving efficiency through centralized services for shared functionalities, a modern modular architecture promoting scalability.

AssetTracker.sol:

Purpose: Coordinates the operation of core asset management procedures such as creation, transfer, tracking, key formation and so forth.

Functionality: Implements prescribed actions under certain conditions so that only authentic and verified transactions are incorporated into the block chain network.

Advantages of the Smart Contracts Module:

Automation: Smart contracts handle asset related processes automatically thus saving on manual input and assuring promptness and accuracy.

Gas Optimization: With a modular structure gas cost is reduced as functionality common functionalities are grouped together into AssetLibrary.sol which is economical.

Transaction Integrity: Design of the module implies that the transactions are completed upon fulfillment of the conditions that support asset-related actions in order to guarantee the security measures for the same.

Scalability: Modular approach makes the system scalable enabling new functions to be incorporated without affecting current operations. Figure 3 shows the system design and the application flow illustrating the verification requirements at each step.[1] This visual representation offers an overall picture on how this application works thereby providing transparency and traceability of the asset management process.

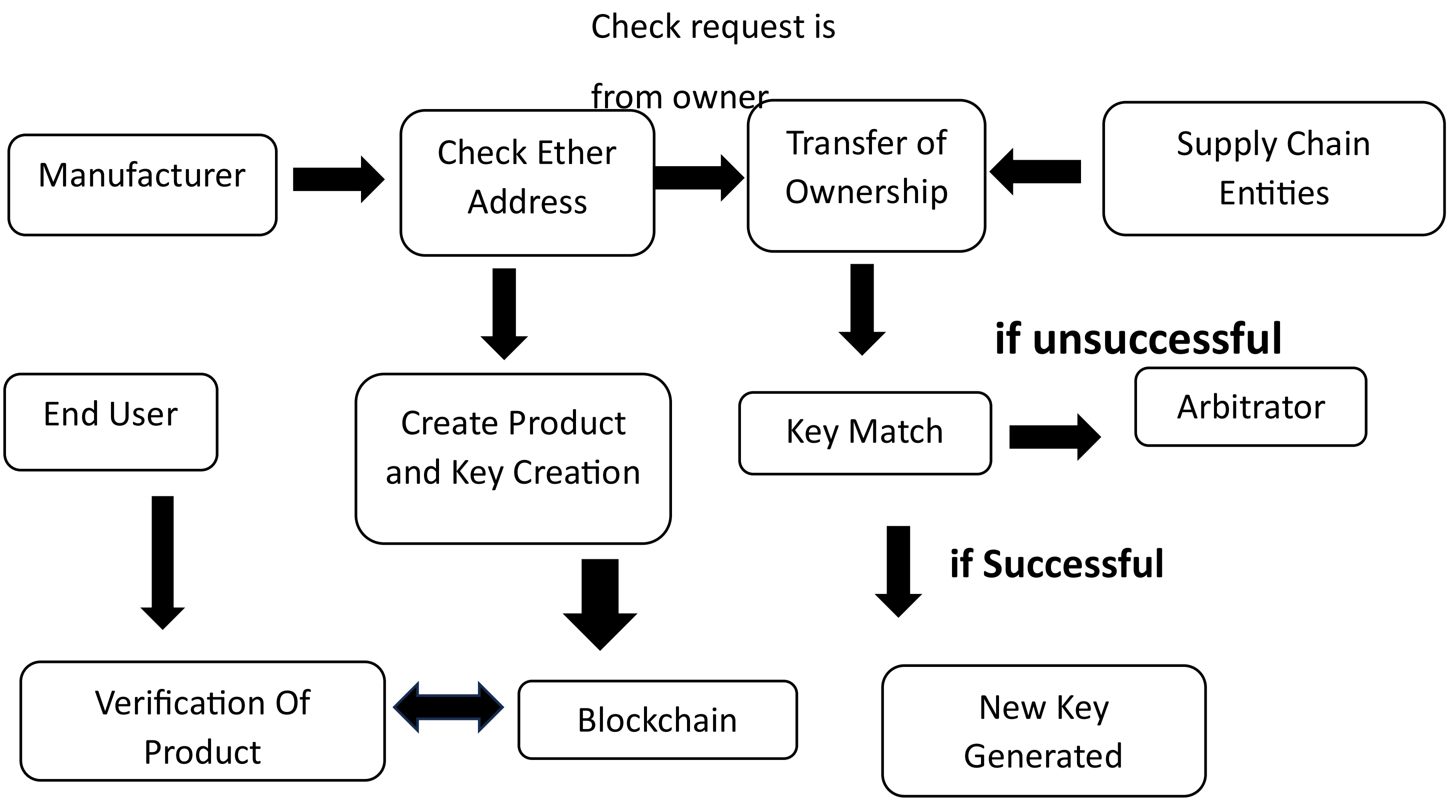

Fig.3:Data Flow Diagram

3.3 DATA PREPARATION

To prepare data for the asset management system with blockchain several important steps. Firstly, it gives structure to the data, defines its format, and lists the different field types to ensure consistency. This is followed by encryption of this data using appropriate cryptographic measures to ensure that the information remains safe and unchanged. Identifies are used with hash functions that help in verification as well as integrity checking. Normalization is used to remove redundancy and arrange data in tabular form for easy retrieval. The smart contracts' specifications are detailed in detail, highlighting the structure as well as the logic of how to interact with information, creating, transferring, and checking.

This is where authentication and authorization mechanisms that govern user access are defined, including roles and permissions. [10]To facilitate seamless data flow across the different systems, interfaces are developed, allowing for easy integration with external systems. Validation checks based on data authenticity and proper authorization guarantees that the information is consistent and true until it is put on the blockchain. There is close monitoring during data migration, which also ensures that data integrity has been maintained after the migration.

Here, users' access will be defined through authentication and authorization mechanisms, with corresponding roles and permissions. Interface is created in order to simplify flow of data among different systems as well as integrating the system with external units. Incorporating validation checks on authenticity of data and authority will ensure that the information remains consistent and true up to when it is added to the blockchain.

The integration of IoT based asset status information with IoT devices for real-time updates is used to deliver timely and accurate information in real time. Backup procedures should be part of normal operations and there should be a backup plan in case of any unforeseen circumstances. There are implemented measures and data retention for addressing privacy concerns and meeting regulatory needs[13]Quality management and version control mechanisms, are put in place to track changes to blockchain data through the establishment of data governance practices. In conclusion, this comprehensive data preparation process forms a solid foundation for safe, reliable, and organized data storage on the blockchain, acting as a vital pillar of an efficient asset management system.

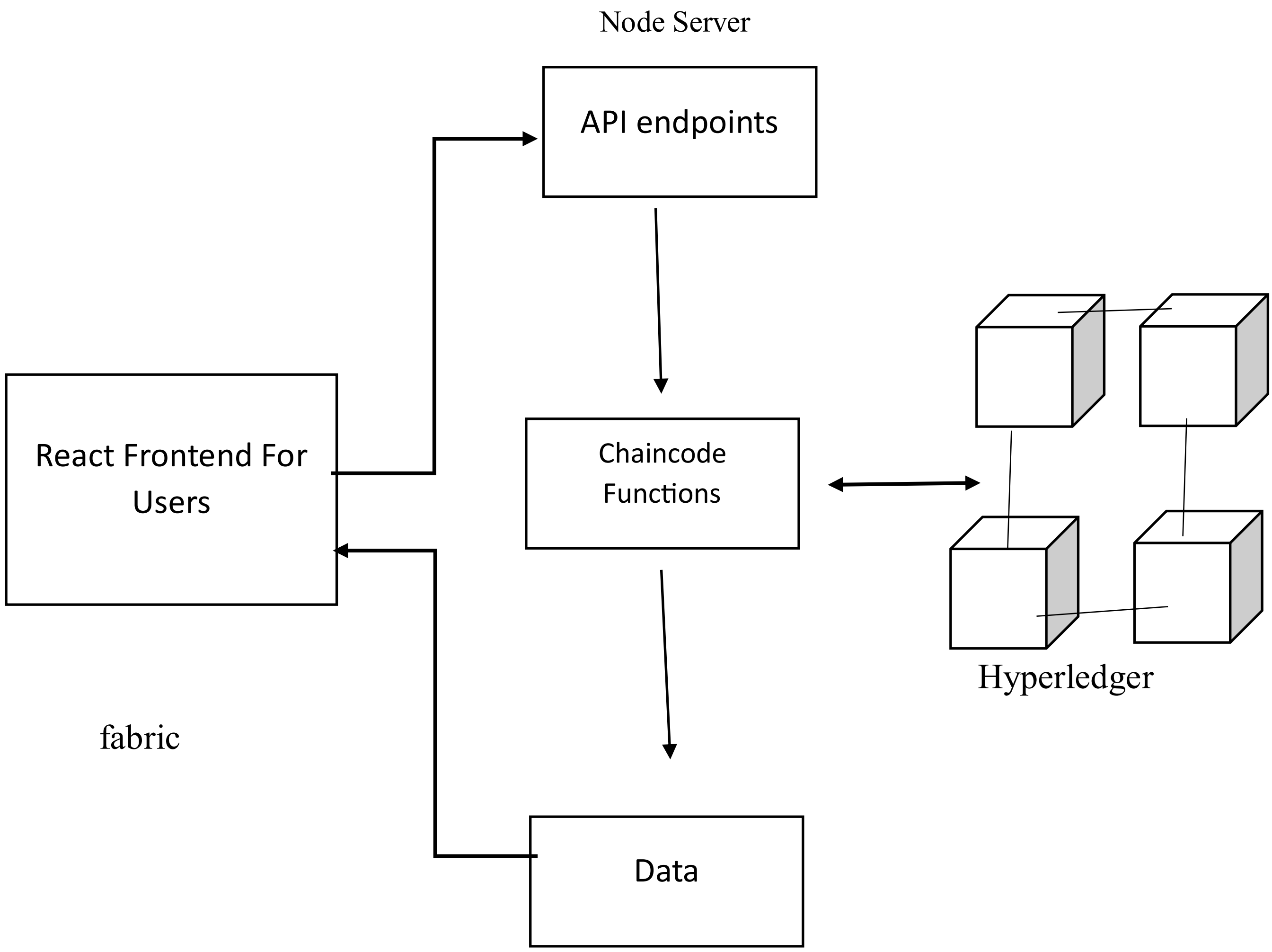

Fig 4: Interaction between the front end and the blockchain network

Table 2.2

Factors	Issues	Solutions with the Proposed System
Blockchain Storage	Sensitive data should not be stored in the blockchain as it may cause problems like deletion of the information when asked by the user.	Due to this, the personal data will be placed in a different storage. The hash reference for the sensitive data is also likely to constitute personal information in the future. Data will not be stored in the blockchain network but cloud storage. The other benefit of not storing data on the blockchain network is speed. Retrieving the consent data is a quick job.
Access log	The biggest problem with the existing user consent management systems is that the users do not know the organizations that access their data.	They will have power and the organisation will be compelled to follow their demands because users can accept or reverse their decision without difficulty. Users can access the history information of their consent details by retrieving it from the installed chain code in the network. Certainly, this ensures that the proposed system is transparent and traceable.
Privacy	Unauthorized users.	Using a permissioned make sure that only authorized organizations remain in the network. In addition, chains can be used for configuring the additional attribute-based controls to the users, giving them finer access based on what is required..
Scalability	Improving the system performance.	Increasing storage and cloud based instances will increase the system's throughput. This can be done through specifying high configured EC2 instances, for example, t2 large, and so on

3.4 ALGORITHMS

Hashing Algorithms:

Purpose: The hash functions are very important as they help to produce fixed size hash values from a variable data size. It safeguards data integrity, while also identifying the info within the chain of blocks. as an exemplification, SHA1 is popularly recognized as being computationally unfeasible to trace back the original information from its hash.[14] Collision resistance means that different inputs will not result in one hash value.

Digital Signatures:

Purpose: Digital signatures ensure authenticity and integrity of a message/transaction . ECDSA is commonly employed in developing and authenticating digital signatures in blockchain. It is a technique in which two different forms of cryptographic keys (private and public) are used making sure a signature can be done using private key while anybody having an access to corresponding public key will verify a signature. It improves security of transaction hence instils confidence.

Smart Contract Execution:

Purpose: A smart contract is a computer program that executes itself and contains the specifications of an agreement. These contracts are interpreted and executed using the algorithms governing smart contract execution, such as EVM of Ethereum blockchain, for example. EVM carries out transactions on the Ethereum blockchain, ensuring that the laws specified in smart contracts are enforced. It enables automatic fulfilment of trust less contracts.

Encryption Algorithms:

Purpose: Sensitive data is protected using strong encryption algorithms, in order to ensure that only approved parties can decode it. An example of an encrypted data algorithm is AES (Advanced Encryption Standard). The technique is known as symmetric-key encryption, using one key on both sides to encrypt and then decrypt. It also helps protect the confidentiality and privacy of any stored or transmitted data in this blockchain network.

Every single one of these algorithms provides a significant boost in the safety, reliability, and efficacy of any blockchain-based asset management platform.[21] These algorithms should be combined in different ways depending on the individual specifications and goals for the project, creating a reliable, strong, and safe blockchain environment.

3.5 IMPLEMENTATION

Programming Language and Frameworks:

React.js (Frontend):

Usage: For the front end development, React.js is chosen as its base that offers building a dynamic, responsive user interface in the asset management system.

Benefits: React.js makes it easier to build complex user interfaces by splitting them into modules. The approach facilitates rendering, faster updates, and easy interaction with users, which together improve user experience.

Solidity (Backend):

Usage: It uses Solidity for backend development to create smart contracts that govern transactions concerning the assets in the Ethereum blockchain.

Benefits: It is a specialized language designed for blockchain applications including writing smart contracts in a secure manner. The syntax and features of Solidity are designed to enable trustless and distributed computing.

Frameworks:

Truffle:

Role: Truffle is a full-fledged development framework that makes it easy to create, compile, and deploy smart contracts. This includes necessary settings and development tools.

Web3.js:

Role: One of them is Web3.js that allows for communication with the Ethereum blockchain. It helps in smooth communication between the user interface and the smart contracts for retrieving of the data.

Software Requirements:

Visual Studio Code:

Usage: Visual Studio Code is the integrated development environment (IDE) chosen for its versatility and ease of use. It provides a robust platform for writing, managing, and debugging code, enhancing the overall development experience.

Ganache:

Usage: Ganache acts as a small local blockchain in a way that developers can be testing and writing of dapps in order to achieve the same functionality as on Ethereum mainnet. It enables developers to work with a local blockchain instance for fast testing and debugging.

Hardware Requirements:

Laptop Specifications:

Minimum Requirements: This requires having a laptop with 8 GB RAM or more for the efficient processing of development tools and applications hence a responsive development environment.

Storage: Project files, dependencies and blocks data must be stored hence taking out 20-25 GB of available space.

Internet Connection: The stable internet is important for the accessibility of online resources, external dependencies, and the blockchain networks throughout the development period.

To sum up, this set up is very picky about using React.js for frontend and Solidity for backend development. These use Truffle and Web3.js for ease in development. The IDE is Visual Studio Code, while Ganache creates a convenient local blockchain environment for testing. These hardware requirements are designed to optimise your development experience and ensure the performance needs of the development tools and applications.

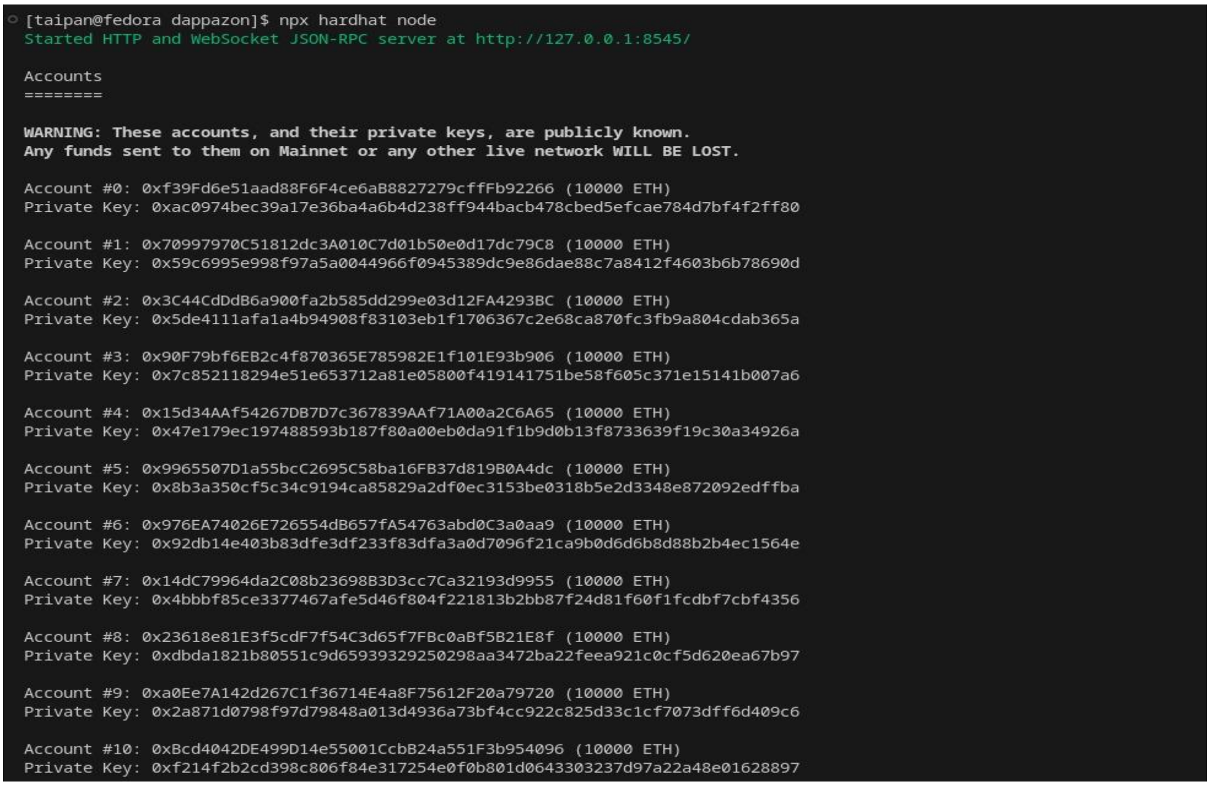

Fig 5: Accounts and Private key

The act of moving contract into a live blockchain network is regarded as a key procedure in the blockchain development environment. This is important for deployment of smart contracts from local networks to real blockchains. The first migration is the fundamental step for productionizing smart contracts' code, usually in languages such as solidity. Framework such as Truffle are used regularly by common developers as an effective way of simplified such deployment process.[15] Truffle helps to configure deployment settings such as the choice of the target blockchain network, gas limits, and others. Migration scripts, being written in JavaScript, illustrate the sequel of events of deploying smart contracts and provide instructions how to do it. Truffle migrates the contracts and Truffle is the one that carries out the migration command. The developers can only do so when migration is successful, such as invoking functions or editing the state, transactions, and so on.. The migration scripts, written in JavaScript, depict the order in which the smart contracts will be deployed and give commands on how that will be done. Truffle executes the migration command and deploys the contracts one after another. Successful migration allows the developers to interact with their smart contracts from the live blockchain, by invoking their functions, sending transactions and editing its state. Users need to follow the documentation of the selected tools and blockchain platform since the details of contract migration can change depending on these aspects.

```
2_deploy_contracts.js
=====================

   Replacing 'Land'
   ----------------
   > transaction hash:    0x573e0ff245a8217b39b4fa80cf685612b4503cd2961a36efca3fb7c01348e531
   > Blocks: 0            Seconds: 0
   > contract address:    0xED2b5139c26123864B1349AC866ad8bE8fcd35B5
   > block number:        3
   > block timestamp:     1701277308
   > account:             0xce42b8455Ac535b69D997E8E42101E4615787979
   > balance:             99.988170068907719813
   > gas used:            3466895 (0x34e68f)
   > gas price:           3.176857843 gwei
   > value sent:          0 ETH
   > total cost:          0.011013832571607485 ETH

   > Saving migration to chain.
   > Saving artifacts
   -------------------------------------
   > Total cost:     0.011013832571607485 ETH

Summary
=======
> Total deployments:   2
> Final cost:          0.011680499696607485 ETH
```

Fig 6 :Deploying Contracts

The deployment of the "Asset" contract to Ethereum block chain is a critical step in the project report. These details are depicted on the terminal window.

Deployment Details:

A contract called "Asset" was successfully deployed to the Ethereum blockchain by a Truffle migration script called "2_deploy_contracts.js". The deployment transaction details are as follows:

Transaction Overview:

Zero blocks, zero time (0 seconds) of deployments. The transaction succeeded creating the "Asset" contract at the mentioned address.

Additional Information:

"Saving migraion to chain" and "Saving artifacts" mean that the action was done correctly and the contract/metadata are saved locally. The "Total deployments: 2" – means that the deployment was made using two contracts "Land", and "Final cost: 0.011680499696607485 ETH" – total cost of two contracts "Land" deployment.

This is an in-depth discussion on the Ganache cryptocurrency wallet interface intended for use with Ethereum development. Let's break down the key components and their details:

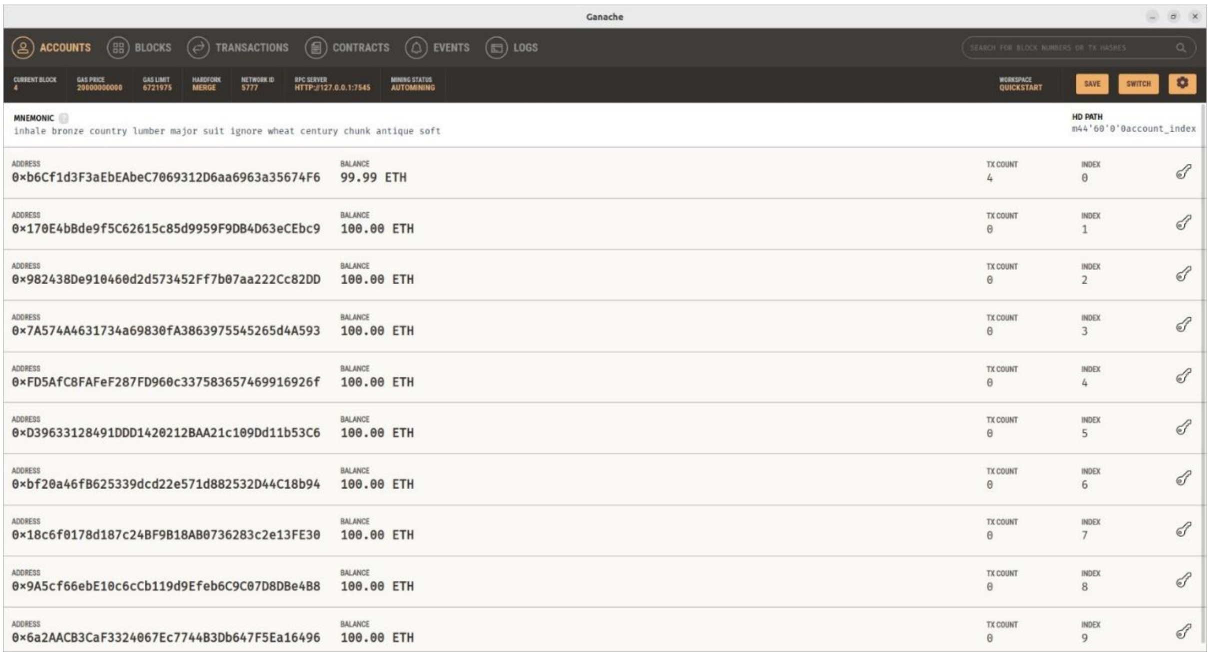

Fig 7: Ganache Interface

Accounts

The list of 10 Ganache accounts with their associated addresses and balances. For example, the top account has an address of 0xxb6Cf1d3F3aEbEAbeC7069312D6aa6963835674F6 and a value of 99.99

Blocks

Blocks gives information on the block of the time. This includes the block height (10), timestamp (2023-11-29 20: Gas limit (21 million), time stamp (14:24 UTC) and difficulty (3.12M).

Transactions

Among them is a list of 18 different transaction entries bearing an individual hash hash, a block number and a sent by address. Hence, the highest transaction has a hash of 0xb65c687e4e0a373891fafe04056e0d167414055 and a block number of 10.

Contracts

There are zero (0) contracts indicated under the Contracts section. This part offers an insight into implemented smart contracts.

Events

The logged events are displayed in the Events section. Every event is composed of information including log index, transaction hash, and contract address. For example, the first event has a log index of zero, transaction hash of 0x9A5cf66ebE10c6cCb119d9Efeb6C9C07D8DBe488 and a contract address

Logs

It contains a table of logs, which are messages that contracts generate. Just like in the case of events, every log contains information such as log index and transaction hash among others.

In brief, Ganache furnishes an extensive user interface that allows Ethereum programmers test and simulate blockchain features. This information reveals about accounts, blocks, transactions, contracts, events, and logs that can be a wonderful tool for Ethereum development and testing.

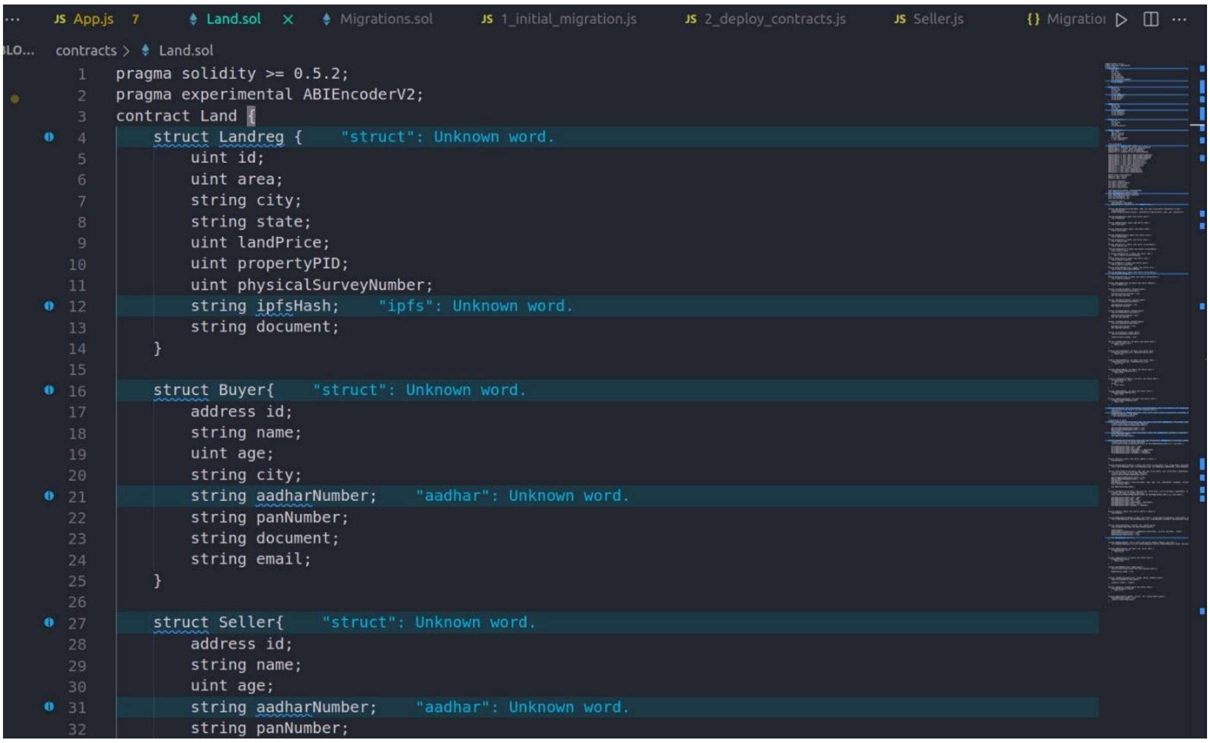

Fig.8: Executing Solidity

Solidity, pragma statement specifies the compiler version, which the code will be compiled against. It ascertains that the code complies with a specific solc version.

3.5 KEY CHALLENGES

While using block chain for asset management, several key challenges may arise in its development and implementation. These challenges include:

Scalability:

• The scalability problem lies with handling a big number of assets and transactions on the blockchain, this may negatively impact the system as it grows.

Integration with Legacy Systems:

• It is not an easy task to integrate blockchain-based asset management into existing legacy systems so that they work together without obstacles.

Regulatory Compliance:

• Complying with the changing regulatory environment, including meeting industry specific governance requirements is always harder especially in industries such as these.

User Adoption:

• It may take effort for blockchain based asset management interfaces to gain widespread adoption and acceptance among users, requiring user-friendly designs and education programs.

Data Privacy and Security:

• It is essential to ensure that private and secure information on the block chain regarding the assets is protected and this can be difficult to achieve by using strong encryption and access control measures.

Smart Contract Security:

• Smart contract design is critical since it should be done in a way that eliminates vulnerabilities and exploits to add another burden.

Interoperability:

• Interoperability with other blockchain networks as well as external systems can be a challenge, especially in case of various protocols and standards.

Cost Management:

• The problem with blockchain infrastructure, development, and ongoing maintenance is that they may be costly to manage, especially if there is a requirement for ongoing upgrades.

Data Migration:

• The transition from the existing asset management systems to a blockchain based solution involves data migration, which should be planned and validated properly.

Educational Barriers:

• It can be difficult to overcome education barriers and ensure that students, users, and decision-makers understand how blockchain technology and its benefits work.

Incentive Mechanisms:

• It is difficult to design efficient incentive schemes for participants in the blockchain network, encouraging them to cooperate within the framework defined by the network rules.

Reliability and Availability:

• It is important to ensure that the asset management system remains reliable and available continuously, and downtime and recovery from unanticipated failures can prove to be challenging.

Technology plays a major role in addressing these issues as it creates opportunities for efficiency through the use of ICTs. Such implementation usually incorporates different stakeholders and appreciation of industry peculiarities.

CHAPTER 4: TESTING

4.1 TESTING STRATEGY

Adoption of a robust strategy for testing Asset Management System supported by blockchain is designed to guarantee the integrity, safety, and functionality of the system. Testing of the system includes multiple phases in which such elements as smart contracts and blockchain integration are tested on the correctness of functioning in harmony. Integration testing follows to check end-to-end integration of asset management system within the blockchain and how it integrates with other systems.[16] Functional testing is paramount to ensure that important functionalities such as assets creation, secure transfer and real-time tracking work properly. Other critical consideration includes security testing, assessing smart contracts vulnerability, and ensuring correct access controls deployment. Scalability and transaction throughput are measured in performance testing in order to check the efficacy of a system at different times.

UAT checks the user interface and collects user feedback to ensure the system meets the expectations of its targeted users. Whenever updates or modifications occur to prevent the introduction of new changes, regression testing is performed. It is also important that data integrity and privacy testing is done to confirm that recorded data in the blockchain cannot be changed, and all sensitive information was correctly ciphered. Backup and restore procedures are tested to ascertain whether they can effect a successful system recovery in the event of disaster. Compliance tests the Asset Management System's adherence to prescribed legal and regulatory requirements. The comprehensive testing strategy would aim to test the robustness, security, and the ability to manage digital assets in a secure blockchain environment.

UAT, therefore, is critical as it ensures that the system conforms to the expectation of the users. Evaluation involves inspecting the user interface, as well as actively soliciting user feedback to verify the suitability and usability of the system for users. The company ensures that it carries out thorough regression testing for purposes of protecting themselves from untoward results caused by system upgrades or changes.[14] More so, testing should include checking the integrity of data and ensuring that privacy standards are intact on the blockchain. After data is inserted into the block chain, it cannot be modified and confidential information is properly encoded. Backup and restore procedures also get tested to ascertain their reliability in supporting system reconstruction during contingencies. Lastly, compliance testing verifies that the Asset management system conforms to the required law and regulated laws. This complex approach to testing does not just test on the strength of the system and safety of the platform, it also seeks to find out if the system is able to keep the digital assets in safe keeping within the secure walls of the block chain technology.

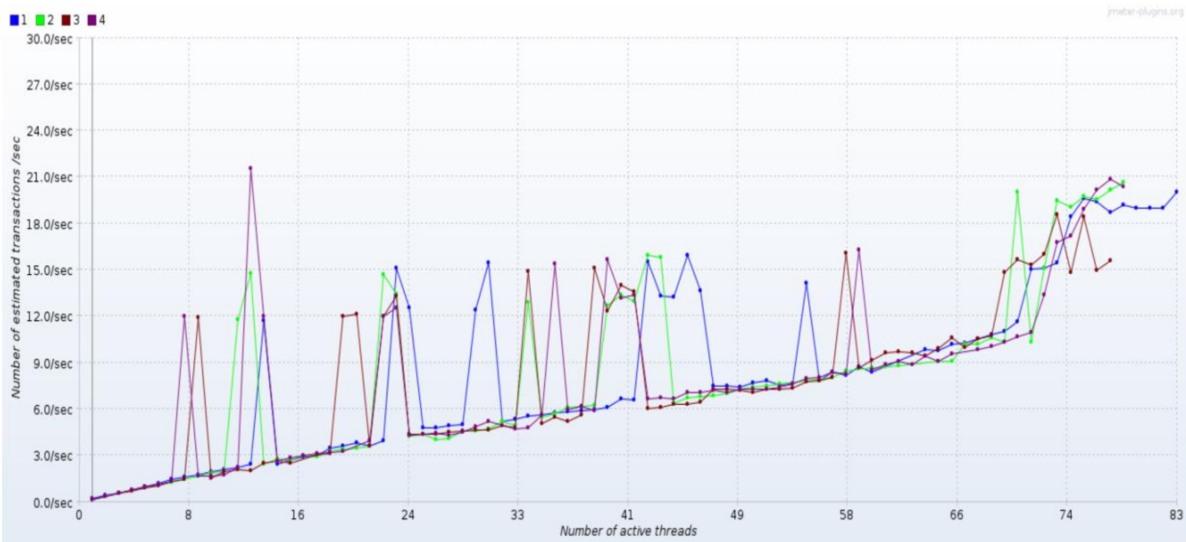

Fig 9 : Overall results of the throughput in the local machine.

The experimental design is set up in such a way as to measure the system's throughput using a load test conducted using j meter. Particularly, it examines the read throughput which measures how long it takes to get the data out of the network. The configuration with test consists of 100 threads and one seconds as ramp ups, which imply increase in the amount of users gradually Carry out the load test by means of j meter to measure the system's throughput. In particular, it looks at the read throughput which involves the speed of retrieving data from the network. First ramp ups include 100 threads within one second thus referring to an increase in the number of users gradually.[8] The experiment was done for four times so as to detect these differences and achieve more reliability. Colour coded results for each iteration are shown in figure 09. For more reliability, the experiment is performed four times with an aim of detecting such variations. Figure 08 shows the results of each iteration, using color codes (1, 2, 3, 4). Such a graphical representation provides a visual comparison of the system's read throughput across several trial runs and helps understand how this asset management system performs under different conditions of overload.

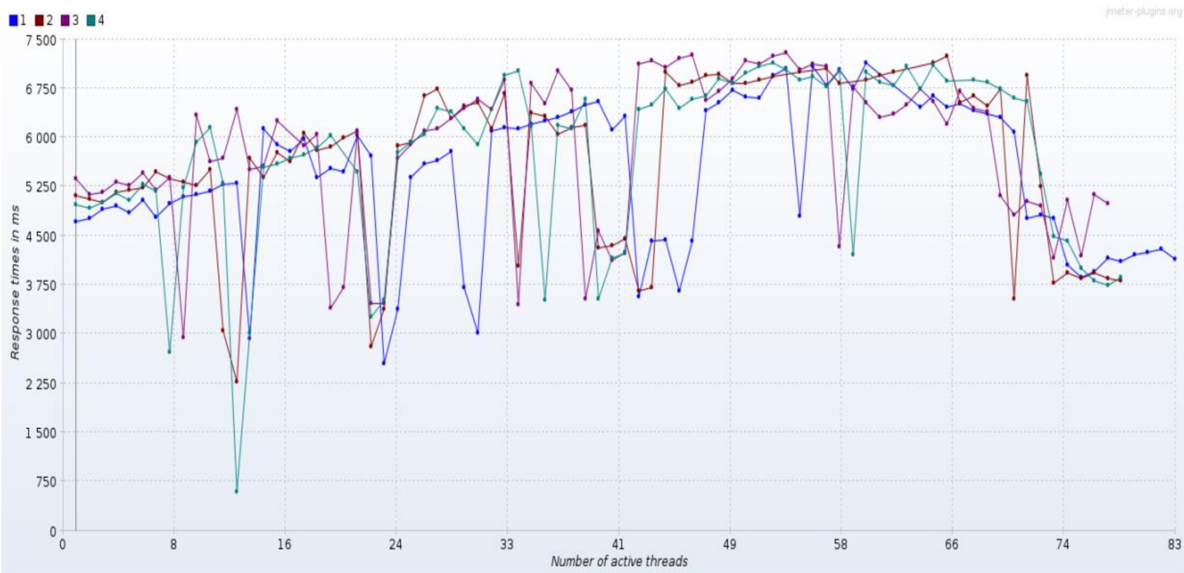

Fig 10 : Combined results of the response times in a local machine.

This is represented in figure 9, which presents the correlation between the amount of active threads (along x axis) and the transactions per second (y axis). Significantly, there are about 20 failed transactions out of 100 users, thus, the local implementation has an average success rate of approximately 80%.TPS is assessed at 9.5%. This percentage is not far from 80% success rate. The first performance metric considered in this study, which was applied only on a single machine, explains why its success rate was lower than cloud implementation counterparts. On this note, the throughput for reading is incredibly low and the test that was conducted using a J-meter and a hundred user responses, indicate that the test results will be combined in future trials. The response time measures how well the system works at different traffic loads and is a key metric in evaluating the system's efficiency or performance. The TPS is measured as 9.5 which is comparable to the 80% success ratio. The low success rate in this performance metric can be attributed to the fact that it was implemented on a single machine, as it did not outperform cloud implementations. In this context, the read throughput is remarkably low while the system's response time, obtained from a J-meter load test with 100 users, shows combined results in the forthcoming trials. A critical metric that evaluates the system's efficiency or performance while operating at different traffic loads is the response time.

CHAPTER 5 : RESULT

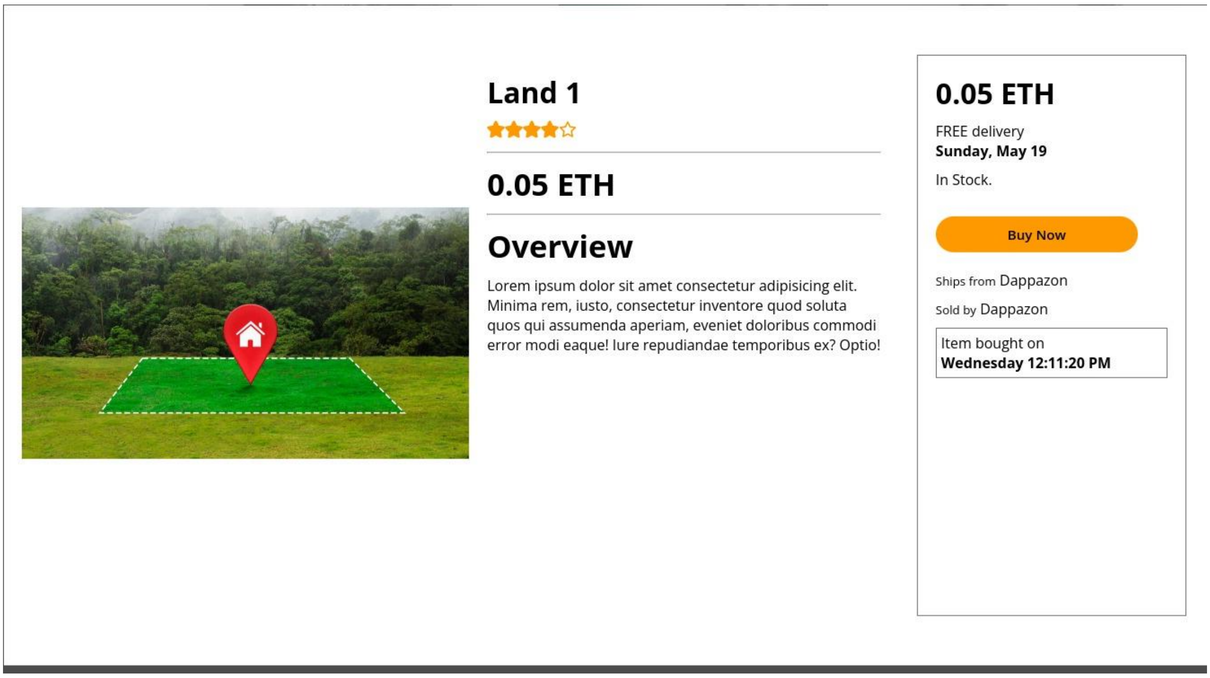

Fig 11:Item bought

The given photo indicates a glimpse of the Ganache development platform, an Ethereum blockchain development tool. Here's a detailed breakdown:

Blocks

Block 258142: Mined on 2023-11-29 at 11:13:53.

Block 4100538: Mined on 2023-12-29 at 11:23:33.

Block 8: There were no transactions for Block 8.

Accounts

Two accounts are visible: "QUACKSTART" and "GAE D."

Transactions

Two transactions occurred at specific timestamps: one at 29 November 2023, 11:13:54 and the other at 29 November 2023, 11:13:53.

This snapshot gives a glimpse into recent block mining, timestamps, accounts, and a set transaction details. Block 8 shows no transactions meaning that it could be an empty block or a block containing other types of data such as mining data. Nonetheless, the transactions' special features, like their contents and persons concerned, cannot be comprehended based on the given facts. The picture is probably a graphic illustration of this blockchain's recent transaction and the number of existing accounts in the Ganache development environment.

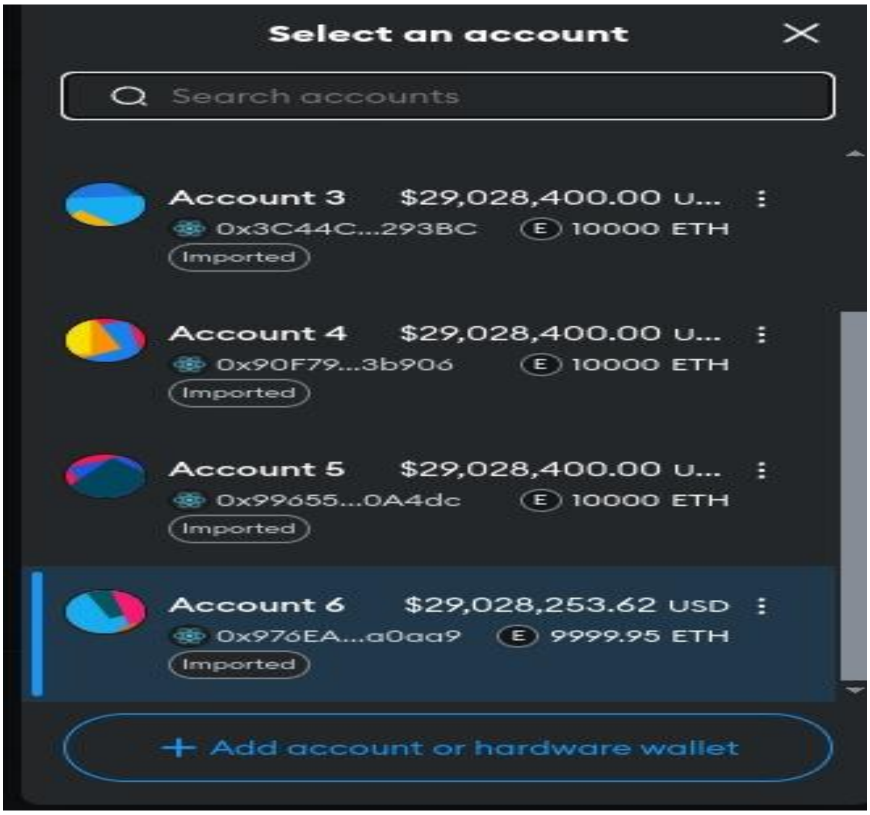

Fig 12:Accounts Information

Displaying relevant information about the status of the local blockchain in the Ganache Ethereum development environment. Here's a summary based on the provided text:

Blockchain Information:

Current Block Number: The block number at the end of the chain.

Gas Price: The price at which a transaction is executed (gas).

Network ID: It will then be indicated within the Ethereum network being used (e.g., Mainnet, Ropsten, or a local test network).

Transaction Details:

Transaction Hash: This is a hash which represents a unique identifier of each transaction.

Gas Used: The amount of gas expended by the transaction.

Gas Price: Gas price in the transaction.

Value Sent: The number of Ether sent in the transaction.

Sender's Address: The sender’s Ethereum address.

Recipient's Address: Recipient’s or contract Ethereum address.

Transaction Types:

Completing the Transaction: Representation of a typical Ethereum transaction in which Ether is transferred from one address to another.

Contract Call: Invokes a specific function and suggests an interaction with a smart contract.

Contract Creation: It shows a new smart contract creation in the blockchain.

It offers details about the current events in the Ethereum blockchain and explains the transactions carried out, transaction type, among others. It is about “completing the deal,” “call for a contract,” and “creating a contract.” The transaction may be anything like paying for the goods or services or anything else related to smart contracts.

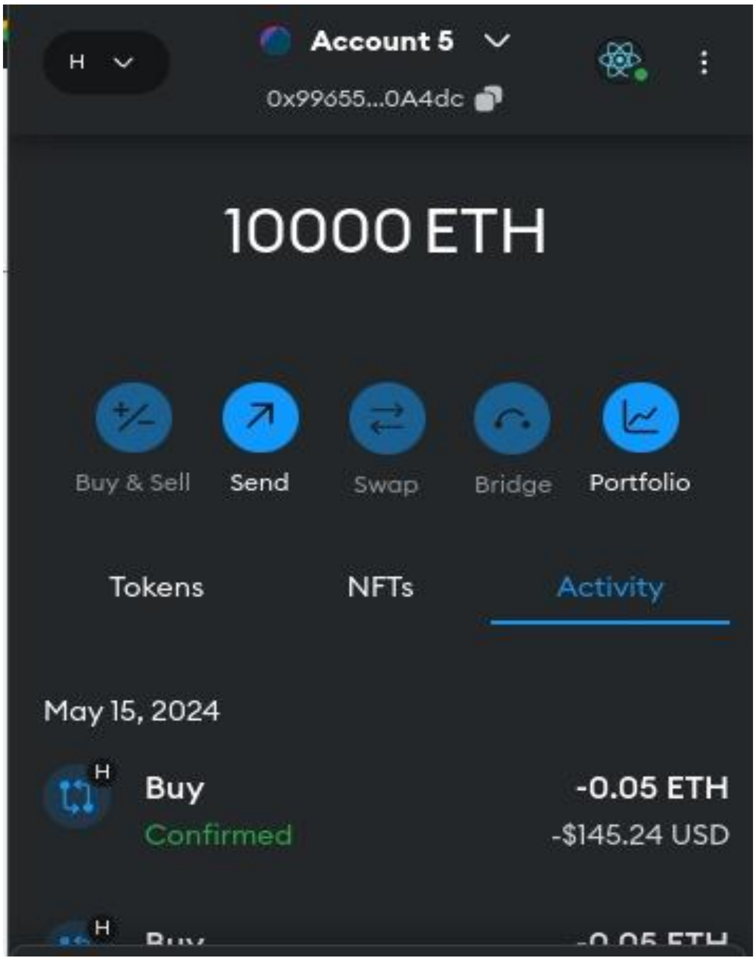

Fig 13 : Metamask Wallet

The following figure shows an Ethereum wallet management application, which is hosted locally and has various features to satisfy users' requirements. The "My Accounts" page displays two imported accounts "User1" and "User2" with their corresponding Ethereum balances (100.75673865 ETH and 99.20507889 ETH). The application enables users to effortlessly find, import, and link to hardware wallets. There is a 'make it for sell" button which shows that there is a function that enables users to post their Ether for sale with a placeholder value indicating a forthcoming feature[2]. The application seems to run locally on localhost and port 7545 and may be considered a test or development environment. A 'make it for sell" button is available meaning that a feature that allows users to list their Ethers for sale with placeholders is available but not enabled. It looks like it is running locally on localhost:7545 like a test or development environment.

CHAPTER 06: CONCLUSION

There are high chances that the use of blockchain based consent management scheme of personal data could improve security, traceability, and transparency in data transmission. This explains why blockchain technology can be incorporated in an asset management system to make the processes used today more efficient. Using a blockchain will completely transform the way that assets are tracked, managed and traded, solving some of the main problems that characterize traditional systems.

Yet in all technologies there are questions to be sorted out. For future research in case of asset management systems based on blockchain, it is important to settle the above mentioned shortcomings related to the suggested prototype. The measures include data integrity, user friendly processes for consent updates and cost implications in production ready systems. The upgrades like blockchain for validation as well as advanced access controls like ABAC should be part of a more elaborate security framework. Such blockchain-based asset management systems will, however, demonstrate their viability, usefulness, and potential to be embraced by people, when rolled out in real-world deployment scenarios.However, these are technological questions to be sorted out. In order to enhance the proposed prototype for asset management systems built on blockchain, it is essential to settle the above mentioned drawbacks.[24] Measures such as data integrity, user friendly processes for update of consent and costs implication during production readiness system. Besides, the upgrades of blockchain for validation and ABAC (advanced access controls) should be included in a more sophisticated security system. However, their efficiency, practicality and acceptability by people will prove true only when they are deployed within a real world scenario.

However, to verify the success of any blockchain-enabled asset management systems, it needs to be practically tried on real circumstances. The process would provide significant input regarding the appropriateness of the software in practicality and user acceptance in field, as well as potential challenges. Thus, without this empirical feedback loop, the system would not be perfected, and issues addressed in field, ultimately leading to greater transparency and security.

1.2 FUTURE SCOPE

The future scope of this blockchain-based asset management system is extensive, opening up many opportunities for refinement and further application in different contexts. Several key areas of future development and enhancement can be envisaged:

Scalability and Throughput Optimization:

• Scalability should be considered as the asset management develops more and attracts more users. It is essential to enhance the capacity of the system by making it scalable and enhancing its throughput when handling more transactions.

Enhanced Privacy Protection:

• Although the current implementation is secured, future upgrades ought to include highly advanced confidentiality-ensuring mechanisms. Additionally, sensitive asset oriented data can be further concealed by including techniques such as zero knowledge proofs or privacy oriented consensus.

Data Integrity Measures:

• In order to strengthen the reliability of the asset information, future steps should include mechanisms that verify data integrity collected from users. Addition of more data validation mechanism that may utilize blockchain inherent immutability trait would improve the reliability of data stored in the blockchain.

Usability Improvements:

• The system's success depends on user experience. Going forward, the emphasis needs to be on improving user interfaces, simplifying consent updates, and making sure that the system is friendly to all parties involved.

Cost Optimization Strategies:

• The subsequent studies should focus on reducing costs of introducing a viable application by implementing optimization strategies. Evaluation of resource allocation, minimization of overheads, and economic feasibility for various deployment methods are involved.

Incorporating Data Validation with Blockchain:

• Blockchain for data validation is one area that can be developed in the future. However, this aspect does not stop here but could be expanded to cover all the ways to verify information related to different assets in its entirety.

Attribute-Based Access Control (ABAC) Implementation:

• It is possible to enhance the asset management system's security posture by integrating advanced access control measures like ABAC. This would allow for more granular control over permissions, hence enhancing trust and security of both organisations and users.

However, the future scope of this blockchain-based asset management system encompasses scalability, privacy, data integrity, ease of use, economies of scale, and enhanced security measures.[25] Integrating advanced technologies and systems shall serve further to uphold this program as a trustworthy and modern asset management solution within the industry.

1.3 KEY FINDINGS

The key highlights of this project entail the adoption of blockchain technology in an asset management system which led to significant shifts in transparency, security, and efficiency. Asset management has been characterized by increased transparency, thanks to the introduction of a decentralized ledger system by blockchain. It created an immutable and transparent history by recording and stamping every transaction in relation to ownership and movement of assets. The blockchain security enhancements as one major finding, mitigating the risk of discrepancies and providing an intelligible and auditable record of all asset related activities. The block chain technology which uses hash functions and the fact that it cannot be changed was used by leveraging it to make the system handling the asset more secure. Smart contracts, which are agreements written in code, became a critical factor in decreasing dependence on intermediaries thus reducing the likelihood of fraud and amendments in asset exchanges.The standout result was efficiency gains derived from automation. Smart contracts made easy the processes of asset transfer, maintenance, and auditing. The transaction automation not only facilitated running the business but also ensured following set rules in the transaction that increased system effectiveness. One of the significant advantages of the project was mitigation of fraud in asset trading. There are some issues that contributed significantly in reducing fraud in this case. Blockchain provided transparency into real time confirmation of assets ownership and authentication, while fractional ownership ensured asset market's inclusion to minimize fraudulent transactions. This was a landmark discovery brought about by the decentralized form of blockchain's global accessibility. Blockchain broke down geographical barriers and made asset markets accessible to many more stakeholders.

There was also an improved operational visibility through real time monitoring of the assets, with users receiving up to date information on the condition and location of the assets.Therefore, the crucial points reveal the considerable benefits of integrating blockchain technology in the asset management system. The upgraded transparency, safety, efficiency, and inclusivity underscore why blockchain is a game-changer in changing tradition ways of managing and trading assets.

1.4 LIMITATIONS

The limitations of this project include:

Scalability Challenges:

• However public blockchain networks tend to become unsustainable with a high transaction flow. The large volume of transactions might make processing the project difficult at the time; hence slow, with high expenses.

Energy Consumption:

• Blockchain related energy consumption, especially with regards to proof of work consensus protocols, can lead to high costs and impact the environment. This may however create a cause for environmental concern and might end up increasing operation costs particularly in the long run.

User Adoption and Education:

• Although the blockchain technology is still in the infancy stage, the adoption process of the users might be delayed due to lack of comprehension or familiarity with the technology.

This may prove difficult as one would have to educate users and stakeholders about what blockchain entails.

Regulatory Uncertainties:

• There is an ongoing development of the blockchain and cryptocurrency regulation. Possible uncertainties are expected. Compliance with existing regulations and preparation for future changes may prove difficult, affecting the project's legal and regulatory compliance.

Interoperability Issues:

• However, achieving interoperability with existing systems and standards could prove difficult. Interconnecting with legacy systems while maintaining efficient communication across various blockchain networks or external databases is not easy.

Data Privacy Concerns:

• Nevertheless, there is a question whether such data can remain private. However, storing data on a public blockchain, even in encrypted form, may become an issue of privacy, particularly when it comes to personal information or sensitive data.

Costs of Implementation:

• It would be necessary to invest in setting up and maintaining a blockchain-based system with both start-up and running costs. Such expenses could be infrastructural, developmental, operational, and might be difficult for underfinanced projects.

Smart Contract Risks:

• Although empowering, smart contracts are not immune to vulnerabilities. Smart contracts can be susceptible to security flaws leading to either breaches or undesirable outcomes. However, making sure that smart contracts are robust and secure is difficult.

Limited Smart Contract Flexibility:

• Smart contract is difficult amend after deployment. A possible limitation with this is that it might not be so easy to undertake any changes or upgrades on the system down the line.

Token Volatility:

• Their values tend to be rather unstable in case a project entails the utilization of tokens and digital money. Such fluctuations can create financial risks and uncertainties that may burden users and other stakeholders involved into the project.

It is important to understand and tackle the existing shortcomings to enable proper deployment and longevity of the blockchain- based asset management system.

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