Utilizing Blockchain Technology to Improve Accountability, Security, and Transparency in Digital Asset Management

MSc Research Project
MSc Cyber Security

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Project Submission Sheet

Student Name:	Sharan Sridhar		
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AI Acknowledgement Supplement

MSc Research Project

Utilizing Blockchain Technology to Improve Accountability, Security, and Transparency in Digital Asset Management.

Your Name/Student Number	Course	Date
Sharan Sridhar	MSc Cybersecurity	12-08-2024

This section is a supplement to the main assignment, to be used if AI was used in any capacity in the creation of your assignment; if you have queries about how to do this, please contact your lecturer. For an example of how to fill these sections out, please click here.

AI Acknowledgment

This section acknowledges the AI tools that were utilized in the process of completing this assignment.

Tool Name	Brief Description	Link to tool

Description of AI Usage

This section provides a more detailed description of how the AI tools were used in the assignment. It includes information about the prompts given to the AI tool, the responses received, and how these responses were utilized or modified in the assignment. **One table should be used for each tool used**.

[Insert Tool Name]	
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This section includes evidence of significant prompts and responses used or generated through the AI tool. It should provide a clear understanding of the extent to which the AI tool was used in the assignment. Evidence may be attached via screenshots or text.

Additional Evidence:

[Place evidence here]

Additional Evidence:

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Utilizing Blockchain Technology to Improve Accountability, Security, and Transparency in Digital Asset Management

Abstract:

The rise of cloud storage services has fundamentally transformed how data is stored and accessed, offering a solution for individuals as well as organizations that is highly flexible with near unlimited scalability at reasonable costs. Still, as cloud storage became more common, a number of problems arose fears around privacy and latency are two notable examples. It was of great importance to ensure the safety and integrity of data stored in cloud environments, as a potential leak or breach might take financial damages for years. Moreover, traditional cloud storage systems struggled to deliver low latency responses and guarantee a high availability even under networking failures or server crashes (A. Ghani et al., 2022).

Keywords: Blockchain Technology, SHA Hashing Algorithm, Digital Assets

1 Introduction

Management and Trading of Digital Asset, by Kaal et al. in the digital age ((2020)), crystallizing a variety of electronic resources from cryptocurrencies and element art, to data files. Digital assets are, at their most basic, intangible items in a digital format that operate as mediums of exchange for value or ownership and are typically dependent on complex systems validating the transfer between counterparties. Though very efficient and convenient, such assets do also present hurdles when it comes to concerns of security the proven authenticity of an asset and its trace through. This unbelievable trust effect and efficiency of digital transactions hinges on accurate representation and reliable management of these assets.

As such, blockchain has emerged as a potent weapon since it possesses attributes like distributed and immutable Series that can enhance the handling of such assets. In its working, it has ledgers that are distributed that record all transactions and are honest ways untampered methods of verifying who owns something or the changes in the ownership. The SHA hashing algorithm, used

primarily in the operation of blockchain technology are considered to be important for binding the data with a hash as this provides possibility of creating unique hashes associated uniquely with digital information by ensuring that it has not been altered without authorization.

The project investigates the use of blockchain technology and SHANODE as hashing algorithm to achieve greater consistency, transparency and security in digital asset management systems. The aim is to create an end-to-end model that tightens the verification and provenance of digital assets, making them more traceable and reliable. Through the decentralization of blockchain and immutability, it provides a reliable solution for important problems in digital asset management to further ensure that these assets are working properly (ie buying up) trading confidence. Blockchain networks are by nature quite complex but this particular initiative is aiming to make a real world product that caters for how digital assets need to be managed today.

- What would be some of the toughest parts about creating a blockchain underpinning digital asset tracking and how can you protect it from tampering to also have an effective traceable authentic data for supply chain?

The project aims to enhance digital asset management by utilizing blockchain and SHA hashing for improved reliability, transparency, and security. Chapter 1 introduces the framework for addressing key challenges and ensuring asset traceability. Chapter 2 reviews advancements in blockchain, digital transformation, and AI, identifying gaps for a web-based application integrating SHA hashing. Chapter 3 details the research methodology, including literature review, system design, and applied techniques. Chapter 4 covers the implementation process, including blockchain setup, SHA-256 integration, Django development, and system testing. Chapter 5 concludes by highlighting the project's success and proposing future enhancements for scalability and interoperability.

2 Related Work

This part will examine the breakthroughs of blockchain safety, relevant business applications or AI alliance and digital transformation together with important study results and current trends

Digital Transformation and Market Efficiency

Market efficiency and banking sectors are the most influenced ones by digitization. Elaad et al. Khoury et al. (2020) measure the efficiency of football betting odds, finding that whilst market-wide prices reflect outcomes it is not uncommon for individual bookmakers to be slow in updating markets and generate inefficiencies Commission rates are down, competition is up and profit margins have shriveled. Gainsbury et al. In Australia, in-play bettors are more likely to be younger and more educated (Hing et al., 2014) but do not necessarily have higher gambling severity levels overall as found by Holdsworth population etal. Our findings suggest that targeted regulations are needed to reduce risks and address gambling harms. Zhu et al. (2024) resolve the bookmaker profit and prediction accuracy trade-off in betting markets by designing online learning methods to allow for more frequent price updates. This unites the profit driven and information seeking purposes, making pricing strategies most efficient. Kulu et al. The depth and stability of banking performance in Ghana is less affected by mobile money transactions, but it does have severe negative effects on overall management efficiency (Dissa et al. The suggest integrating with mobile money services and working specifically for partnerships with mobile operators. Kitsios et al. Research by, 2021) shows that digitalization of the banking sector in Greece is widely accepted but specialized education should be provided for employees to exploit new technologies and structured training systems must, therefore, be established.

Blockchain Security and Attack Vectors

Expanded Vulnerabilities and Mitigation Strategies Through Blockchain Security Research Aggarwal et al. (2021) provide an exhaustive review of various forms of attack, including Finney attacks , race attacks , 51%attacks, eclipse attacks and many more, ranging from Sybil and Distributed Denial of Service (DoS), to routing related. Most are targeted against token-centric applications or known design choices such as target DAO Wallets parity. In summary, their research demonstrates that these attacks are becoming more complicated because of the growing blockchain networks and computing capabilities for executing them, with special emphasis on how a 51% attack would compromise integrity in blockchains. This paper also talks about emerging approaches to improve blockchain security. Hu et al. In a transaction-based classification and detection method is introduced to handle security problems of Ethereum smart contracts. After analyzing 10,000 contracts or so they find four types of behavior patterns and extract the most basic information about our world from them (14 features). Their method classifies contract types

accurately, quickly detects anomalies, and efficiently identifies malicious contracts by utilizing an LSTM network that successfully addresses smart contract security in the Ethereum platform. Shojaei et al. (2021), the role of blockchain in supporting a circular economy (CE) for the built environment. While a decentralized ledger system helps in offering greater transparency and traceability for processing the material to be reused or recycled. The tool gives real-time information on the status of components and its history, which will help to build smarter cities with green construction.

Narbayeva et al. (2020) examine blockchain's integration with autonomous vehicles, emphasizing its potential to enhance cybersecurity and system reliability. Blockchain's immutable records enable real-time data tracking and communication, reducing cyberattack risks. Erdin et al. (2020) propose the Lightning Network (LN) to address Bitcoin's high transaction fees and slow confirmation times. By utilizing off chain payment channels, the LN reduces costs and verification times, enhancing scalability, fairness, and privacy in Bitcoin transactions.

Blockchain in Various Industries

Blockchain technology is transforming various industries by enhancing security, transparency, and efficiency. Li et al. (2020) highlight blockchain's impact on educational digital asset management, noting that its decentralized approach improves data integrity and security compared to traditional, centralized systems. Despite its benefits, challenges such as stakeholder coordination, regulatory development, personnel training, and scalability remain.In healthcare, Haleem et al. In addition, Sang, D. H., & Walter, Z. R.(2021) stresses the ability of blockchain in data security and leverage Blockchain securely share patient data, reduces errors & improves accuracy of records. It also provides decentralized data protection, counterfeit medicine prevention and simplified clinical trials.Enhanced interoperability and cost reductions through smart contracts further underscore blockchain's potential to transform healthcare services.Dutta et al. (2020) explore blockchain's role in supply chain operations, noting its ability to improve transparency, security, and efficiency. By employing decentralized structures, consensus algorithms, and smart contracts, blockchain enhances visibility and business process management across various sectors, including shipping, manufacturing, finance, and healthcare. But, it is also facing obstacles like standardization and system integration. Hussien et al. In a (2021) study , the authors provided blockchain applications in healthcare and present trends, opportunities for security, privacy integrity as well as efficiency.

It expands the sharing of secure data between healthcare providers, for telecare services provision and E-health systems in general as well ass other specific examples such as drug development warranties.Despite these benefits, issues like scalability, storage capacity, interoperability, and standardization remain.Azar et al. (2022) examine the financial stability implications of digital assets using the Federal Reserve's framework. They identify risks within the digital asset ecosystem, including those related to stable coins, valuation pressures, and decentralized finance (DeFi). Although current risks have minimal impact on traditional finance, increasing integration could amplify these vulnerabilities, highlighting the need for stronger regulation and oversight.

AI and Blockchain Integration

AI and blockchain technology integration are changing business practices by improving security with better efficacy. Wang et al. Dedhia and Talsania (2022) cover this one-of-a-kind matchup in their paper by exhibiting how the use of Artificial Intelligence is reinventing digital transformation through creative team effort accompanied with striking strategy design, and blockchain plays an important part in it to ensure secure association & clear data vibes. As a whole, this combination enhances demand forecasting and product quality which directly benefits customer satisfaction indicating its place in modern business. Maree et al. In fact, Mason and Dimanov (2020) focus on using responsible AI principles to choose the classification of financial transactions. They propose a deep neural network model with SHAP (Shapley Additive Explanation) to be included in explainability and hybrid text clustering together with decision tree classifiers. This model balances the benefits of interpretability and complexity by safeguarding explainable results, resilient AI systems when used in financial areas. Min et al. detecting suspicious iot enabled applications horse racing betting systems based(2021). In their analysis, they utilize time series machine learning models to enhance anomaly level discovery and diminish erroneous positives which is a critical element for effective fraud mitigation. Aggarwal et al. Reinventing distributed ledger with blockchain (2021) During the previous section, we discussed that Blockchain is evolving to become a milestone of the revolutionary decentralized secure asset transfer have provided developers transaction transparency at near real time. Sun et al. (2022) introduced MonLAD and MonLAD-W, next-generation solutions in this field to better detect money laundering in real-tome, exploiting the characteristics of laundering accounts while utilizing Ano Score algorithm as a black box.

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Gap Analysis

However, it still lacks a comprehensive end to end web based solution for digital asset management with the application of SHA hashing algorithm guaranteeing both integrity and authenticity in an era where some consider blockchain technology advanced. None of the existing solutions really address how to manage these systems in a dynamic, online world. The objective of this project is to replace that gap by constructing a novel framework more efficient in traceability and verifiability for digital assets but can also solve the issues regarding Blockchain, namely its complexities as well as scalability. This project will offer a new way of managing digital assets and developing cloud-based services with enhanced data management and security.

3 Design Specification

This illustrates the design on how to implement a digital asset management system based in blockchain that will be secured by SHA hashing improving its features, security measures and lightening speed of transactions.

4.1 Proposed System

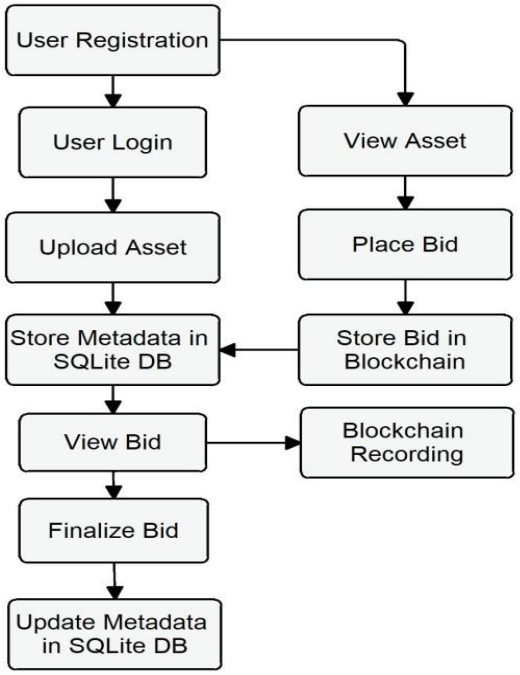


Figure 1: System Architecture

Figure 1: System architecture diagram for a digital asset management system with blockchain support.

- **User Registration:** The first step, where a user gets registered themselves on the platform. To continue on, no doubt you are forced to enter several key personal details and generate login credentials.
- **Login:** Once you are registered, the users would be able to login into the system using their credentials. Authorization will depend on Identity mechanisms where the user's identity is validated before accessing a platform.
- **Asset view:** Users, after logging in are able to see what digital assets are available on the platform. These assets could be any digital property from simple digital files, artwork or documents.
- **Upload Asset:** Allows users to upload new digital asset into the system. In this process, metadata of the asset(such as Title, Description, Owner etc.) are recieved.
- **Store Metadata in SQLite DB :**This phase stores the metadata of all digital assets uploaded by a user during WatchTimeFormatter operation on his local machine. This database acts as repository which helps platform in quick response of any asset data to display on the system.
- **Bid on Digital Assets:** Users can bid for digital assets offered through our platform. Bidding is also a frequent characteristic of various digital asset management systems, and notably those concerned with auctions or sales.
- **Store Bid in Blockchain:** As soon as a bid is placed, this data will be encrypted and recorded on the blockchain. This means that you bid is sound, safe and impossible to tamper with. The application of this info through using blockchain technology ensures that the bid information is immutable, thus lends trust to all parties concerned.
- **Blockchain recording:** The bid, along with all corresponding transactions are registered on the blockchain. This is true otherwise the entire transaction would have only been a figment of our collective imagination hence this recording serves as an irrefutable permanent record guaranteeing accountability and transparency.

- **View Bid:** Users can see the live bidding going on for an asset. Third, this data is stored in the blockchain for accuracy and transparency
- **Bid Finalization:** After the completion of a bid period or when an end user decides to finalize its bidding process, it needs to acquire and conduct transaction-processing. Indeed this could refer to a possible ownership transfer of the digital asset which was up for grabs.
- **Update_metadata_in_sqlite_db:** when you has won a bid, then contract allow to change metadata of digital assets(like ownership or status) on chain data will be written in local storage(sqlite db).

It leads to a transparent and secure flow essential for processing digital assets. By leveraging blockchain technology and other additional database systems, like traditional SQLite databases; users can store metadata with efficiency and process critical transactions in a secure manner. This system design proposition is ideal for applications where the trustworthiness of digital asset matters most; based on using a blockchain to meet its goals.

4.2Block chain Design

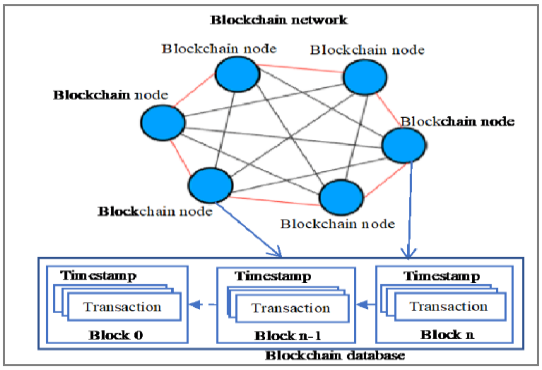


Figure2: Blockchain Architecture

Built on a decentralized ledger, the design of blockchain is essential to keeping data secure and immutable in the new system for managing digital assets. It's a string of data that represents the history of transactions, forged into blocks and tamper linked to its previous transaction. It is a peer-to-peer network consisting of several nodes where each node holds its copy and validates the transactions by mechanisms such as PoW (Proof of work), or PoS. The entire network is decentralized to eliminate single points of failure, and so the ledger remains consistent throughout. It records and confirms all transactions of any digital assets, which could be the changes in

ownership or transfer between participants, on a permanent immutable history for increasing asset traceability and reliability. There are also smart contracts implemented during development to ensure some tasks run efficiently and more securely in the system.

4.3 Cryptographic Algorithm

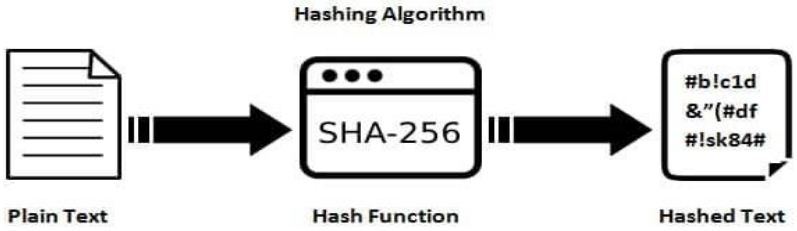


Figure3: Hashing Algorithm

A common use case is making sure data within the system has not been tampered with, which requires cryptographic hashing via Secure Hash Algorithm (SHA). SHA converts an input data to a hash of fixed size (a 256-bits with SHA-256). This is the fingerprints, for every digital asset or transaction. This hash changes A LOT with any modifications to your data even the tiniest one produces totally different meta-hash, so trying unauthorized change is nothing but self-distraught. In blockchain, blocks are securely linked by SHA hashing in that the hash of a block follows into the next one. That way, if you tamper with a block all the number of transactions after that would also change consequently making its hash invalid because it has changed and this will not match up to other blocks copy on every node in our network. This chaining mechanism means that by virtue of the humble nature of SHA hashes, digital assets will be truly authentic and reliable as a result which is essential for security and trust in these blockchain based systems.

4 Implementation

You can get the source code through here: This implementation describes how we could build a secure blockchain based digital assets management system using SHA-256 and Django.

1. Building a Blockchain Infrastructure: The Digital Asset Management System creates and sets up the private blockchain network that models based on your business. A blockchain is essentially a network of nodes where each node is an individual participant and designed to safely process

transactions in real-time. The network is decentralized and scales out such that all data is consistently replicated across every node with no single point of failure.

2. SHA-256 Hashing Algorithm Integration: The data integrity is protected using a system that integrates SHA 256 biometric hashing algorithm. SHA-256 processes every digital asset and transaction leading to a unique hash value. The hash values are then placed on the blockchain, enabling unauthorized changes to asset data to be identified straight away protecting both the authenticity and integrity of assets.

3. Django, which is a high- level canonical python web framework, used to develop the web-based application. The built-in features of Django such as its authentication, management systems for databases and an admin interface makes a good base to start with.Django is bundled up with all these features so the developer does not have to worry about setting it manually. Users can manage digital resources and perform transaction operations through the application, as well as make assets more traceable by enabling users to view asset histories or validate authenticity of assets.

4. Database Management through SQLite: As a database management system, the lightness and integration ease with our app present is what makes us pick different for this role. It saves metadata and transaction records in structured form for simple retrival operation along with an easy access control method by the application. The blockchain may handle the decentralised aspect of data storage, and a local database supports the web application by rapid access to current information.

5. Binding system components: To make data flow between the blockchain, SQLite database and user interface smooth physically bind all of them. This consists of connecting and speaking rules to guarantee a steady kingdom on the entire system. Or alternatively these can be bound which create data flow that downloads one source of change and updates to all components, so a collection only has to update changes in the system.

6. After extensive testing and configuration, it is launched in production. This involves testing the transaction handling of the blockchain, SHA-256 hashing accuracy, Django application reliability and SQLite database performance. The errors identified in tests are handled and system is tested to be optimised for performance and security.

7. Deployment The last part of the cycle is installing your system in production. This entails also setting up the infrastructure required to provide real-time usage by an end user, making sure everything is running smoothly so it does not knock off in public access. This in turn allows for user interaction with the system to control and exchange off digital assets ensuring a more secure, transparent and reliable blockchain based solution.

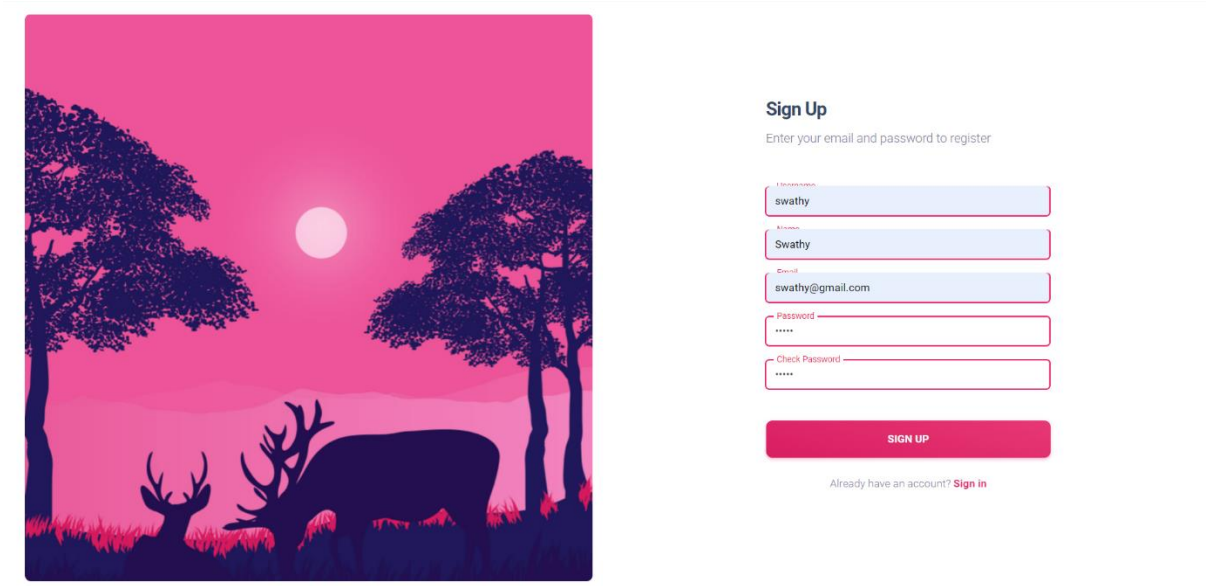


Figure4: Sign Up Page

Figure 4 shows the sign-up page. This is a standard sign up page where users can register with their username, name, email and password details. It will save all user application information in a sqlite database.

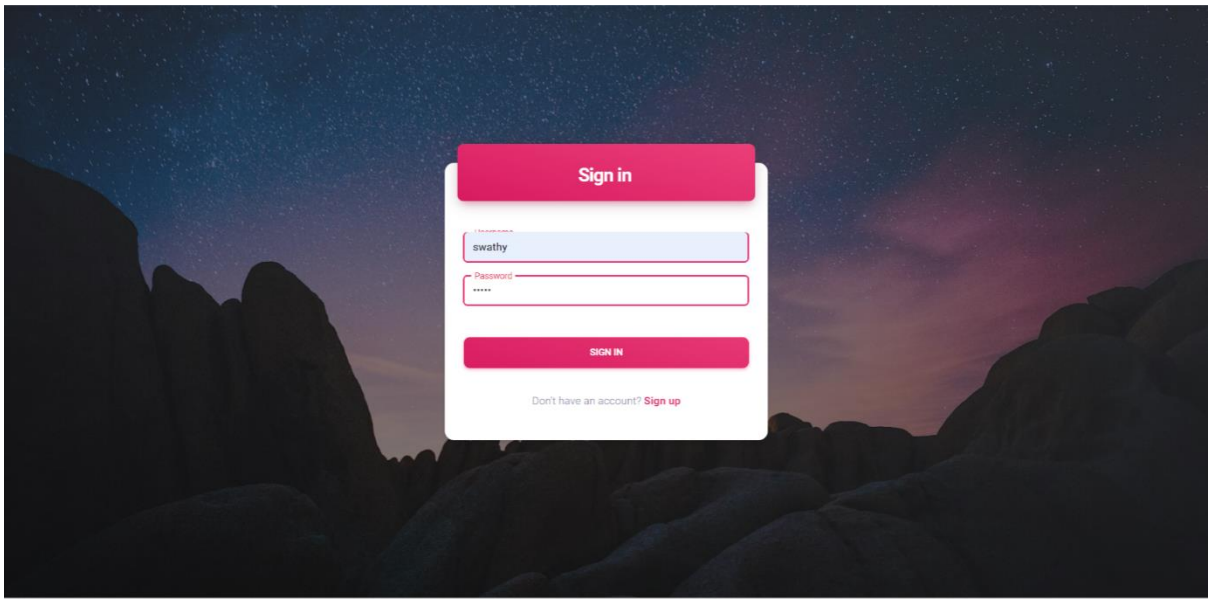


Figure 5: Sign In Page

Figure 5 shows the Sign-In page. So, these registered users can login into the system. The user is sent to the home page only if both of his username and password are correct. Users who enter a wrong credentials or without account cannot log in and not access homepage.

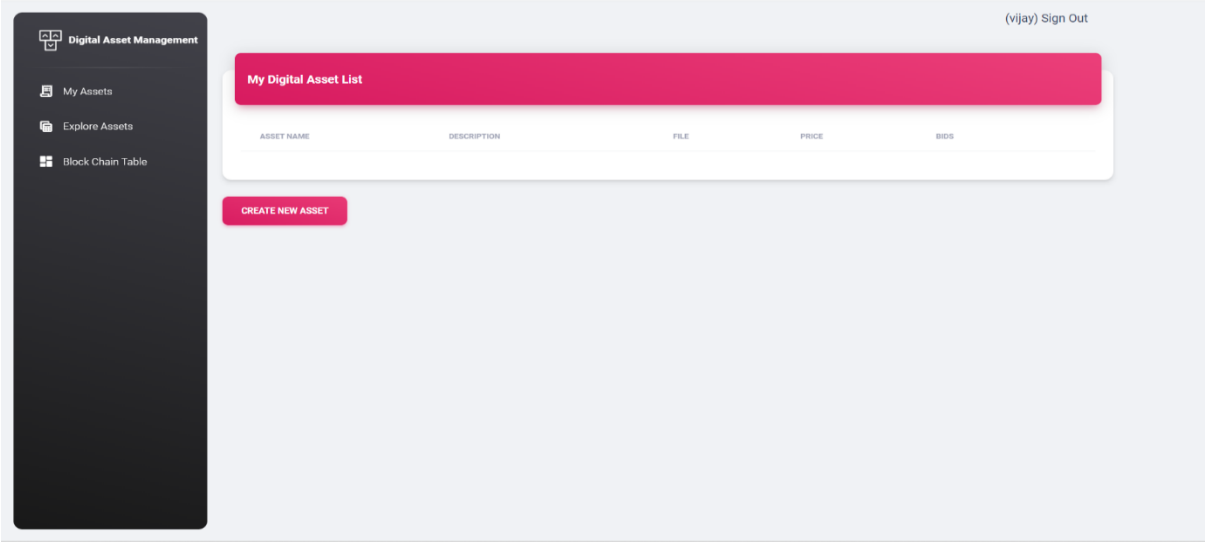


Figure 6: Home Page

On the Home Page as in Figure6, users can explore digital assets uploaded by others and have the option to ‘Create New Asset.’ The sidebar provides options such as ‘My Assets,’ ‘Explore Assets,’ and ‘Blockchain Table.’

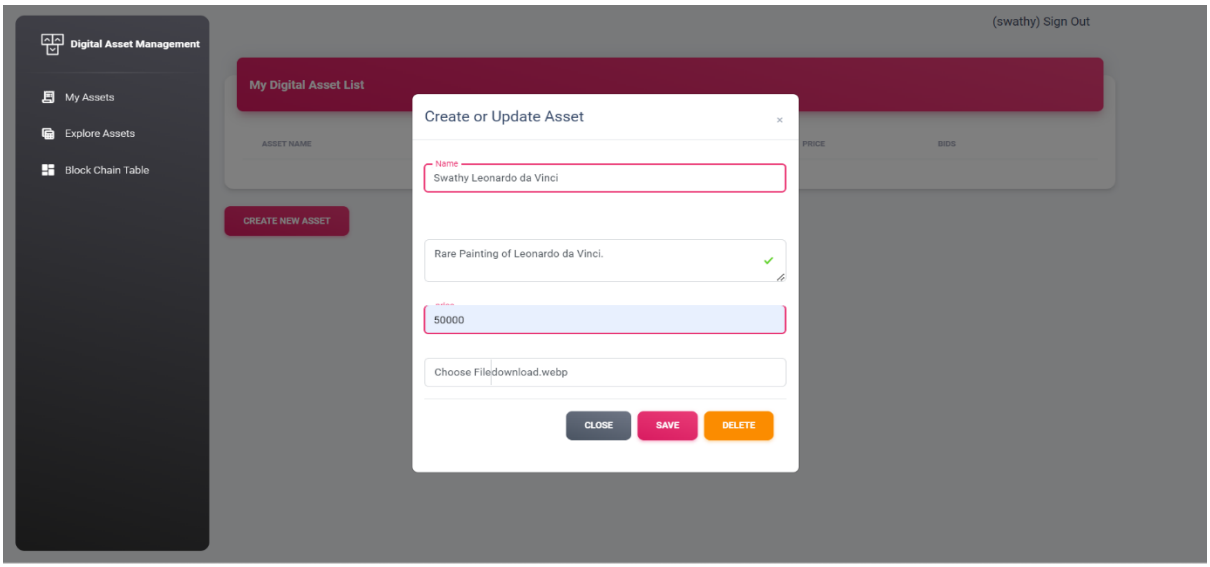


Figure 7: Create Asset Page

To upload new digital assets to the system, users are taken on this Create Asset Page similar as in Figure 7. By entering details like Digital Asset Name, Description and Price along with the asset file they can create a new asset to sell. At this step, the metadata of the asset is gathered. Swathy, User uploads a piece of Leonardo da Vinci painting and prices it at 50,000 Rupees.

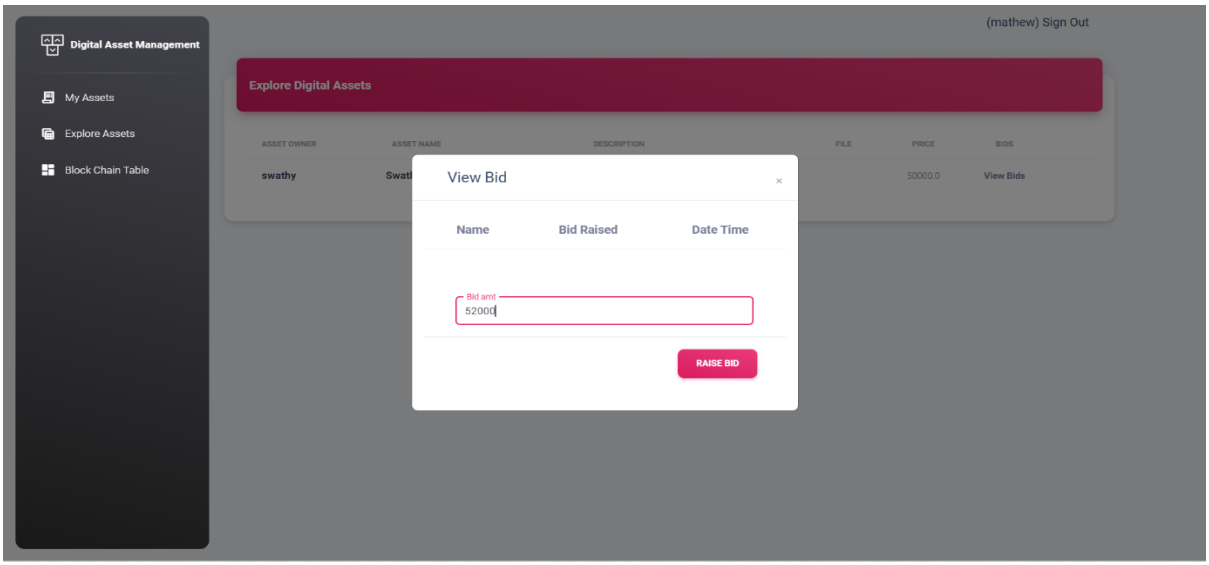


Figure 8: Explore Digital Assets with View Bid Page

In case logged in, the user will be redirected to Explore Digital Assets with View Bid Page as shown below(Figure 8), Here users can see available digital assets on platform. These are things like digital files, images or documents uploaded by other parties. This is a piece of slideshow you get to look at where users can view the assets and should they wish to bid then enter their price. Mathew is interested to buy the painting of Leonardo da Vinci uploaded by Swathy and he has place a bid for Rs. 52,000.

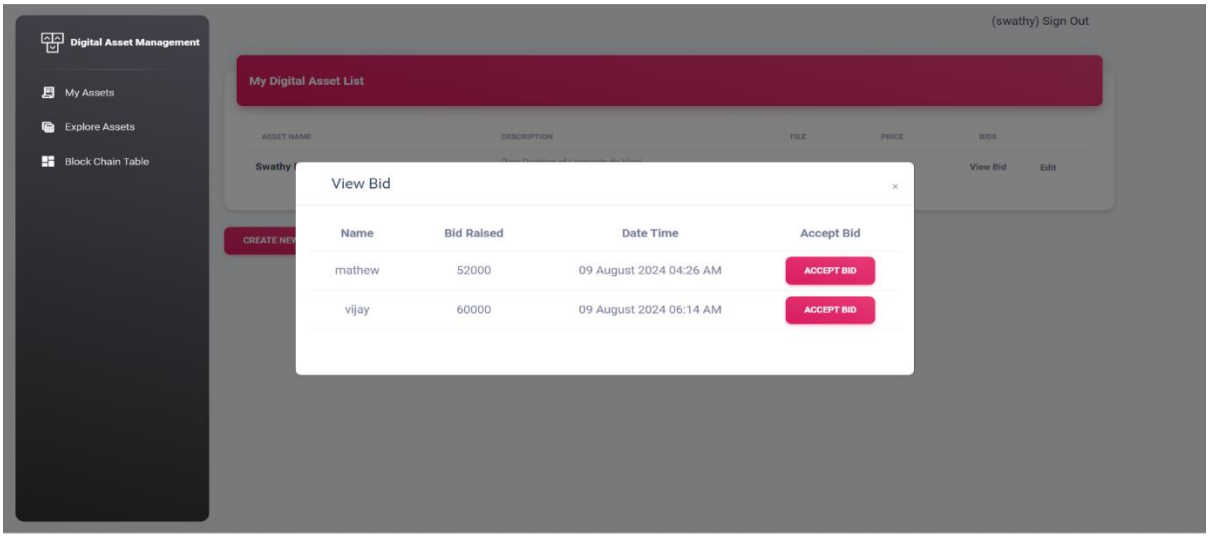
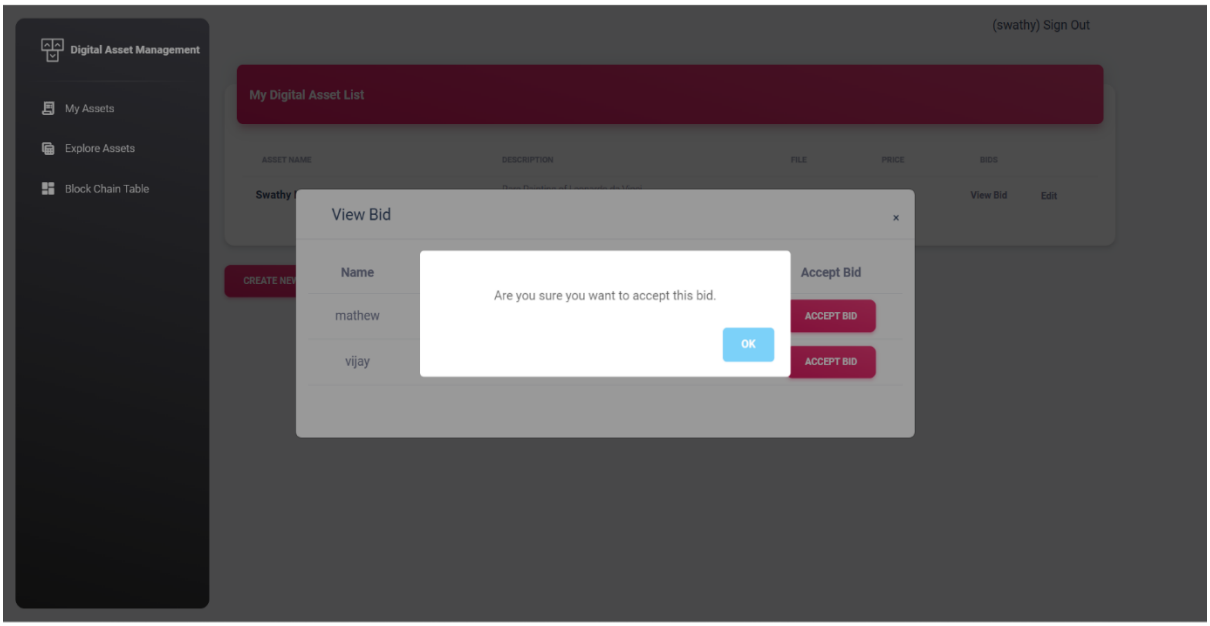


Figure 9: My Digital Asset List with View Bid.

However, on the My Digital Asset List with View Bid page as shown in Figure 9 asset owners can see how many users are interested to purchase their asset and amounts they willing bid. If there are bids, the owner may choose to accept a bid and sell the asset In this case, Mathew has bid 52k for Leonardo da Vinci paining whereas Vijay is ready to offer his maximum price of 60k.



After the asset owner has accepted a bid, this is what you see in Figure 10 For instance, Swathy agrees to the bid from Vijay then confirms if she really wants to sell that painting.

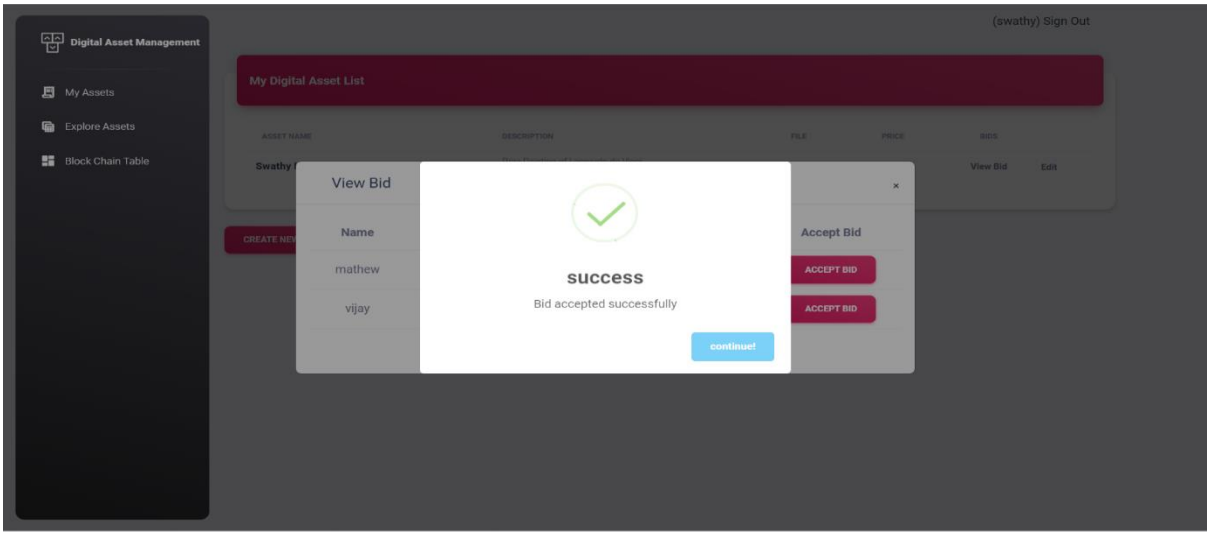


Figure11: Successes Message.

When a user enters into an agreement, the transaction is finalised by being processed by the system. This might require the highest bidder to gain ownership of the digital asset. Confirmation: Accepted the bid for vijay rswagy Confirmed Swathy has sold her DaVinci paintin to Vijaya Figure 11

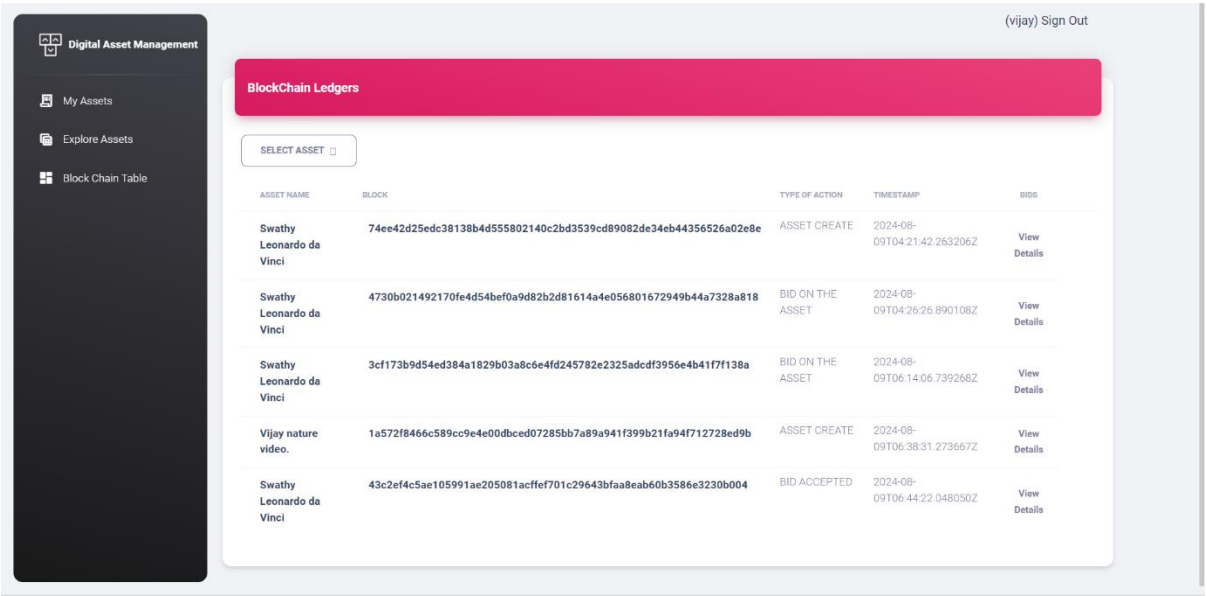


Figure 12: Block Chain Ledgers

Figure 12: Blockchain Ledger. It record the asset related actions sequence and create a hash value of block which is using SHA-256. Swathy started with creating the Leonardo da Vinci asset and then two bids on its. Vijay went on and created a nature video asset later. Swathy finally agreed to sell her Leonardo da Vinci painting for what is called a bid. This is the reason why all of these transactions along their timestamps are recorded in a record called ledger.

5 Discussion

Supplementing the digital asset management incorporating a blockchain technology (SHA-256 hashing algorithm) in tandem reaps many advantages but more so helps to increase reliability, transparency and security. The decentralized network of blockchain guarantees that every asset transaction which has ever been executed is recorded on an immutable ledger meaning it cannot be tampered with providing a clear and visible history of ownership over the lifetime, as well as all bidding processes. SHA-256 hashing lets even more guarantee owing to the unique digital fingerprint that generates for each transaction, indicating when the connected data may be tampered with it stores proof of why this occurred.

Yet, deploying this tech comes not without its own set of challenges. Blockchains are kind of slow as well, and because the different nodes have to downgrade synchronization for them all to come

together nice consensus Further, though blockchain provides solid security and transparency to the processetters, there exists a case that Blockchain alone may not cover scalability issues common with digital asset management at scale.

The project is a successful use case showcasing one of several different implementations which could be derived from blockchain based on creating an incorruptible certainty over digital asset management, but there are many rocks to turn before it may solve issues like scalability and integration with existing systems. Next steps in this area of research might focus on improving blockchain performance and the use of hybrid approaches, as well as developing more intricate user interface functionalities to enhance system accessibility and machinability. These types of discussions emphasize why research and on going development is needed to truly take advantage of what blockchain can offer in terms digital asset management.

6 Conclusion

The project is a successful example of how blockchain technology and the SHA hashing algorithm can truly elevate data security, transparencyand integrity in digital assetmanagement systems. The framework utilizes the decentralized, transparent and trustless features coming with a blockchain to enable the digital assets have integrity to their asset attributes along well tracing back. Although blockchain technology has its own inherent complexity, the outcome is to achieve a sound system that can see digital asset management addresses some specific issues with accountability and capacity for tending future market confidence in handling / trading of digital assets. Future work will involve scaling our system to larger, higher throughput databases extending the applicability of advanced smart contracts incentivizing interoperability with other blockchains for broader use cases and adoption across digital asset management systems.

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