BLOCK CHAIN BASED E-VAULT FOR LEGAL RECORDS

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CERTIFICATE

This is to certify that this project entitled **"E-vault using blockchain to store and transfer legal records**" is the Bonafide work carried out by **Goli Chandana**, **Mohammed Mudassir Hussain, Syed Khaja Mukarram Ajaz, Mohammed Naveed Sharief, Thangallapally Nihal, Vuppula Vashista** as a Major Project for the partial fulfillment to award the degree **BACHELOR OF TECHNOLOGY** in **School of Computer Science and Artificial Intelligence** during the academic year 2024-2025 under our guidance and Supervision.

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Abstract

The legal profession is being hindered by the secure storage, transfer, and verification of legal documents using conventional systems. The E-vault Based on Blockchain to Store and Transfer Legal Records our project envisions a blockchain-based solution to provide security, integrity, and transparency in dealing with legal documents.

The E-vault system provides a secure, immutable environment for legal document management by combining blockchain technology. This means that documents are tamper-proof, with an unchallengeable history of ownership and transfer. The project utilizes a lightweight implementation of blockchain in Python, emphasizing cryptographic hashing and proof-of-work consensus algorithms.

To ensure safe storage of documents, the project has utilized AES encryption and SHA-256 hashing. Document metadata as document hash, name, type, owner ID, and timestamp of creation is stored in the blockchain in an open, immutable record of all document interactions.

An easy-to-use interface is built with Streamlit, providing straightforward interaction with the blockchain system. The functionalities involve user registration and authentication, upload and storage of documentsDocument display and verification, and document secure transfer. Blockchain explorer capabilities are offered for the display of a transaction history and verification of blockchain integrity.

Core Components of Development, Integration and Testing, and Final Touches form the project plan. Lightweight blockchain solution development for document verification, design of a safe documents storage mechanism, open mechanism development for document transfer, and a user-friendly interface are the core goals.

The E-vault blockchain initiative showcases the capabilities of blockchain technology in strengthening the security, transparency, and efficiency of legal document management. With its tamper-proof, self-verifying, and immutable platform, the E-vault system meets key challenges for conventional systems, providing a scalable and viable solution for the legal sector. Potential future improvements would involve smart contracts for rule-based document transfer, biometric verification, and a mobile interface for on-the-move access.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

Introduction

The legal profession is experiencing rising demands for secure, tamper-evident, and dependable management of legal documents. Traditional document management systems naturally lean towards databases as a foundation of storage, leaving behind single points of failure and document and security holes in their integrity. Such systems are not providing verifiable proof of ownership of documents, open transfer histories, and document integrity over time.

Blockchain technology, with its attributes of decentralization and immutability, addresses all these challenges.

Through its use of cryptographic methods and distributed ledger technology, blockchain can bring the integrity, transparency, and security of documents of law in a manner independent of trusted intermediaries. This project, "E-vault using Blockchain to Store and Transfer Legal Records," proposes the development of a blockchain platform for storing and transferring legal records securely, ensuring document integrity, and allowing open and immutable history of document transactions. E-vault system utilizes a light version of a blockchain and advanced as well as encryption algorithms to maintain an efficient as well as a secure document storage system for legal documents. Our project uses Python to implement blockchain, emphasizing the use of cryptographic hash functions as well as proof-of-work consensus algorithms to authorize transactions and safeguard the blockchain. AES encryption as well as SHA-256 hash functions are also used by the system to make stored documents' confidentiality and integrity assured. One of the outstanding aspects of the E-vault system is the user interface, which is being provided through Streamlit. The user interface has interactive functionality with the blockchain system and also supports functions like user registration and authentication, file upload and storage, document verification and presentation, and secure document transmission. The user interface also has an integrated blockchain explorer through which users can view transaction history and verify blockchain integrity.

1.1 Problem Statement

The legal profession has been facing pressure, a lot of pressure, regarding the issue of securely storing legal documents. This pressure, it seems, has become even more intense, mainly

because traditional systems of document management, well, they just have their limitations. Some of the issues involved are things like the need for proof of ownership. It's a thing that must be done, the ability to offer clear and undeniable proof, proof that shows that the document belongs to someone. Without that, it's really not secure enough, is it?

And then there's also the issue of transfer histories, the need for them to be clear, transparent, and tamper-proof. That's what is needed. The transfer histories, they should allow for easy tracing, and there must be no chance of tampering, no way of altering anything. It's important. This is crucial to the security of the document itself. And without these features, without verifiable proof of ownership and the transparent transfer histories, the legal profession might just face problems, serious problems.

Tamper-Proof Integrity: The ability to ascertain that the documents have not been tampered with without any indication.

Transfers: Security vulnerabilities in centralized systems are often bypassed. Many things, like the single point of failure, can be taken advantage of. And there's this issue of inefficiency, too, in handling large amounts of documents. It's a big problem when it comes to processing and managing many of them at once, which traditional document management systems, which tend to rely on centralized databases and access controls, can't really address effectively. These systems often need third-party involvement, which complicates things even more. It's clear that they cannot meet the new challenges faced, and something else is needed.

For verification, which could be seen as something that might cause some security risks and might add to the cost when doing transactions. Furthermore, these kinds of systems do not really give completely tamper-proof histories or a fully certain way to prove ownership transfers in a clear way.

The aim that this project wants to reach is connected with the making of an E-vault system, which is going to be developed using blockchain technology so that some problems related to these concerns may be addressed.

The problems regarding the security, transparency, and immutability of blockchain technology are things that have raised concerns. The E-vault system will definitely help with certain things, like making sure that documents stay intact. A lightweight blockchain solution will be used for authenticating documents. This will be done by using cryptographic hashing and proof-of-work techniques.

The system will, of course, make sure that the documents are securely stored, as there will be a design for a secure storage system. The security will involve AES encryption, which is something widely considered safe and effective in encrypting information.

SHA-256 Hashing and its Potential Implementation: In terms of document transfer, one might think it's a good idea to set up a way for document exchanges to be more transparent. Something like a mechanism that's open, which allows for the movement of documents to be permanent or something like that. It may seem beneficial to have this sort of system.

Then, the interface. It could be designed in a way, where, for example, it would be easy enough to use, and it could be made with Streamlit, which is something that could help, perhaps, legal professionals to use the technology. It may be useful in some way, but, then again, the ease of use could vary.

As for the **audit trail**, there could be, in theory, some sort of record of document transactions, though one would not know exactly how to set it up in a way that fully supports every possible detail of these transactions. A comprehensive trail, which might sound good in principle, could provide some information, but it's not clear if it would be enough.

By using blockchain technology along with stronger encryption methods and a system that's designed to be easy to use, the E-vault system provides a system that is open and secure. This system could also be expanded and adapted, making it flexible for different uses. This technology, which has been made to be both secure and open, offers flexibility and adaptability. It's clear that the E-vault system was designed to work in a secure manner while also being flexible, which could open up various uses. It seems that the idea behind this system is to make something that can be secure, flexible, and easy for users to interact with. The E-vault system was made with these main objectives in mind—ensuring security, openness, and flexibility—though how these will all work together may depend on specific use cases and implementations.

Chapter 2

Literature Survey

2.1 Literature Survey Table

Table 2.1.1: Tabular representation of Literature Survey

S No.	Author(s) & Year	Model Used	Parameters	Merits	Limitations & Drawbacks
1	Gamage, H.T.M. et al. (2020)	Blockchain Technology Concepts	Security, Transparency	Comprehensive overview of blockchain applications	Limited focus on specific use cases
2	Kaur, J. et al. (2022)	Smart Contracts Using Blockchain	Contract Automation	Detailed analysis of smart contract mechanisms	Implementation complexity and legal challenges
3	Ali, O. et al. (2021)	Blockchain Utilization Benefits	Efficiency, Security	Comparative study of blockchain functionalities	Generalized findings, lacking specific examples
4	Firdous Sadaf M. Ismail, & Dattatraya S Adane. (2022)	Blockchain Use Cases	Various Industries	Examination of growing blockchain applications	Identifies emerging issues but lacks deep technical insights
5	Ismail, F.S.M., Mushtaque, S.G.M. (2022)	Blockchain with 6G Networks	Connectivity, Integration	Exploration of blockchain integration with 6G	Theoretical approach, limited practical validation
6	Ismail, F. S., Mushtaque, S. G., & Adane, D. (2023)	Blockchain and 6G Networks	Network Security	Addresses potential and challenges of blockchain in 6G	Limited empirical data
7	Sarwar, M.I. et al. (2021)	Blockchain-empowered Accounting Systems	Data Integrity	Proposes secure data vaults for accounting systems	Implementation challenges in real-world scenarios
8	Paul, A. et al. (2004)	Secure Distributed Storage	Fault Tolerance	Early design of secure storage systems	Outdated technology, lacks blockchain integration
9	Hasan, R. et al. (2007)	Secure Storage for	Data Privacy	Requirements for secure healthcare data storage	Focused on healthcare, not generalizable

		Healthcare Records			
10	Li, H. and Han, D. et al. (2019)	Blockchain-based Educational Records	Data Sharing	Secure storage and sharing of educational records	Limited to educational sector
11	Verma, A. et al. (2021)	Blockchain-based Law Record Management	Judicial Records	Secure and transparent law record management	System complexity and scalability issues
12	Gururaj, H.L. et al. (2020)	Blockchain Technology	General Applications	Broad overview of blockchain technology	General, lacks specific implementation details
13	Rupa, C. et al. (2021)	Blockchain for Medical Certificates	Knowledge Management	Distributed application for managing medical certificates	Limited to medical certificates, not broadly applicable
14	Mahamure, S.S. et al. (2020)	Blockchain for Real Estate	Document Protection	Protection of real estate documents using Ethereum	Focused on real estate, lacks generalizability

2.2 Literature Survey Summary

Literature review provides an overview of innovation and applications of blockchain technology across various industries in general. Gamage et al. (2020) have provided a thorough overview of blockchain concepts, its security features, and benefits of transparency [1]. Kaur et al. (2022) explained the application of smart contracts with blockchain along with contract automation and its legal implications [2]. Ali et al. (2021) compared advantages and uses of blockchain technology and its efficiency and security benefit [3].

In certain embodiments, Ismail et al. had discussed the integration of blockchain with 6G networks for future advantages and disadvantages [5][6]. Sarwar et al. (2021) introduced secure data vaults to accounting systems that possess blockchain-driven empowerment, unveiling the technology's ability to enhance data integrity [7]. Verma et al. (2021) introduced a blockchain electronic law record management system, as proof of how it is being used in judicial inquiry [11].

The survey also encompassed initial breakthroughs of safe distributed storage schemes, such as the paper by Paul et al. (2004), which introduced fundamental data on safe storage practices

[8]. Hasan et al. (2007) have discussed healthcare storage needs especially with regard to security and brought into focus privacy of the data [9].

Drawing on the results of these studies, our research is aimed at creating a blockchain E-evault system that can hold and move legally binding documents. With the use of augmented methods of encryption, a light touch of blockchain specially tailored to our needs, and an interface easy to use, the E-vault system caters to important needs like document integrity, security, and scalability. The use of an interface based on Streamlit also enhances accessibility where legal professionals can just speak to the blockchain network without having any special technical knowledge.

Chapter 3

Existing Methods Vs. Proposed Method

3.1 Existing Methods

Legacy Document Management Systems (DMS) use centralized access controls and database-based document management. They have limited capabilities in storing, accessing, and document control but have significant limitations:

- **Centralized Trust Model:** These systems require a trusted center to authenticate documents and control document management to create single points of failure and need to trust system administrators.
- **Document Tampering Detection**: There is limited document tampering detection capability. Any change in a document is not always traceable and therefore could result in integrity violations.
- **Ownership Transfer:** Labor-intensive and frequently time-consuming document ownership transfer procedures, causing delays and potential errors.
- **Audit Trail:** Audit trails do exist but may be altered by administrators and therefore compromise the integrity of the document history.
- **Verification**: Third-party verification to verify document authenticity and thus incur extra costs and potential delays.
- **Security:** Prone to security attacks because of centralized storage, hence vulnerable to hacking and data loss.
- **User Experience:** Normally complex and not user-focused, requiring extensive education to utilize.Blockchain-Based Document Management

Blockchain-Based Document Management

Blockchain technology is a decentralized document management system founded on cryptographic protocols that provide data integrity. Some of the most notable characteristics of blockchain systems are:

- **Decentralized Trust Model:** The trust is distributed across the network, preventing any point of failure and reducing the risk of a single point of failure.

- **Tampering Detection:** Cryptographic hashing provides easy detection of document tampering with high integrity assurances.
- **Ownership Transfer:** Safe and automatic transfer of ownership through blockchain transactions to ensure accuracy and efficiency.
- **Audit Trail:** Unalterable audit trails that are tamper-proof, providing an unambiguous and auditable record of all document transactions.
- **Confirmation:** Self-verifying documents supported by cryptographic evidence, without needing third-party verification.
- **Security:** Improved security via distributed storage and cryptographic methods, rendering it immune to hacking and data loss.
- **User Experience:** Possibly more user-friendly with newer interfaces, but still to be in the early phase of adoption by legal management.

3.2 Proposed Methods

The E-vault system takes advantage of the application of blockchain technology to surpass the inadequacies of traditional document management systems. Our proposed solutions are:

Light Blockchain Deployment

Custom Blockchain: Python light blockchain implementation with emphasis on cryptographic hashing and proof-of-work consensus algorithms for transaction validation and blockchain security.

Document Hashing: Documents are SHA-256 hashed to offer integrity, and the hash is recorded on the blockchain to create an immutable record.

Secure Document Storage

Encryption: Files are encrypted with AES (Advanced Encryption Standard) for confidentiality. Encrypted files are stored locally, but hashes of the encrypted files are stored on the blockchain for integrity validation.

Metadata Storage: Document metadata like document hash, document name, document type, owner ID, and creation timestamp are stored on the blockchain, thereby creating an open and immutable audit history of document activity.

Streamlit Interface

- **User Registration and Authentication**: Streamlit user registration and authentication gateway to ensure secure access to the system.
- **Document Management:** Inexpensive document upload, storage, reading, and authentication, enabling users to access the blockchain platform as they choose.
- **Document Transfer:** Robust document transfer protocol through blockchain transactions in order to enable secure and efficient transfer of ownership.
- **Blockchain Explorer:** Facility to enable users to review transaction history and authenticate the integrity of the blockchain.

Comprehensive Audit Trail

- **Immutable Records:** Transactions are recorded on the blockchain, developing an immutable audit trail that is unalterable.
- **Transparency:** The users are able to view the entire document history, and the system is transparent and reliable.

Enhanced Security

- **Distributed Trust:** Because the blockchain is distributed, it has no single points of failure and is more secure.
- **Cryptography Techniques:** Using advanced cryptography techniques for preserving confidentiality and integrity of data.

Table 3.2.1: Existing vs Proposed Methods

Feature	Traditional DMS	E-vault Blockchain Solution
Trust Model	Centralized	Distributed
Tampering Detection	Limited	Cryptographically Ensured
Ownership Transfer	Manual Processing	Automated & Secure
Audit Trail	Can be Modified	Immutable
Verification	Requires Third Party	Self-Verifying
Cost	High Maintenance	Low Operational Costs
Security	Single Point of Failure	Distributed Security
User Experience	Complex	Streamlined

By merging blockchain technology with sophisticated encryption methods and easy to use interface, the E-vault system provides a secure, open, and scalable solution to the management of legal records, solving the acute problems of traditional document management systems.

Chapter 4

System Architecture and Technical Specifications

4.1.1 System Architecture

The structure of the E-vault has been designed modular in order to facilitate scalability, security, and maintenance. The structure is composed of a number of layers to support specific functionalities. The key components of the system structure are:

1. **User Interface Layer (Streamlit):** This layer is comprised of a friendly and interactive user interface to communicate with the E-vault system.User registration and authentication functionality, file upload and storage, document verification and display, and secure file sharing. The interface also includes a blockchain explorer to display history of transactions.
2. **Application Logic Layer (Controller):** The layer provides simple application logics, i.e., user login, document processing, and transaction processing. It acts as the middleman between the blockchain layer and the user interface for simple interaction as well as information sharing.
3. **Blockchain Layer:** The deployment of blockchain technology is done via this layer. It has a proprietary light blockchain, with emphasis on proof-of-work consensus algorithms and cryptographic hashing for authenticating transactions and securing the blockchain. It provides document integrity and an open and immutable record of document transactions.
4. **Document Storage Layer (Encrypted Storage):** It is responsible for secure storage of documents. Documents are AES (Advanced Encryption Standard) encrypted and hashed using SHA-256 for integrity verification. Encrypted files are maintained locally, and their hashes are added to the blockchain.
5. **Authentication Layer (User Management):** This layer verifies and controls users. It offers secure access to the system through user registration, login, and session management. User information is stored securely through salted password hash storage.

6. **Database Layer:** The layer holds non-blockchain data such as user information and document metadata. The layer facilitates fast retrieval and management of data required by the application logic layer.

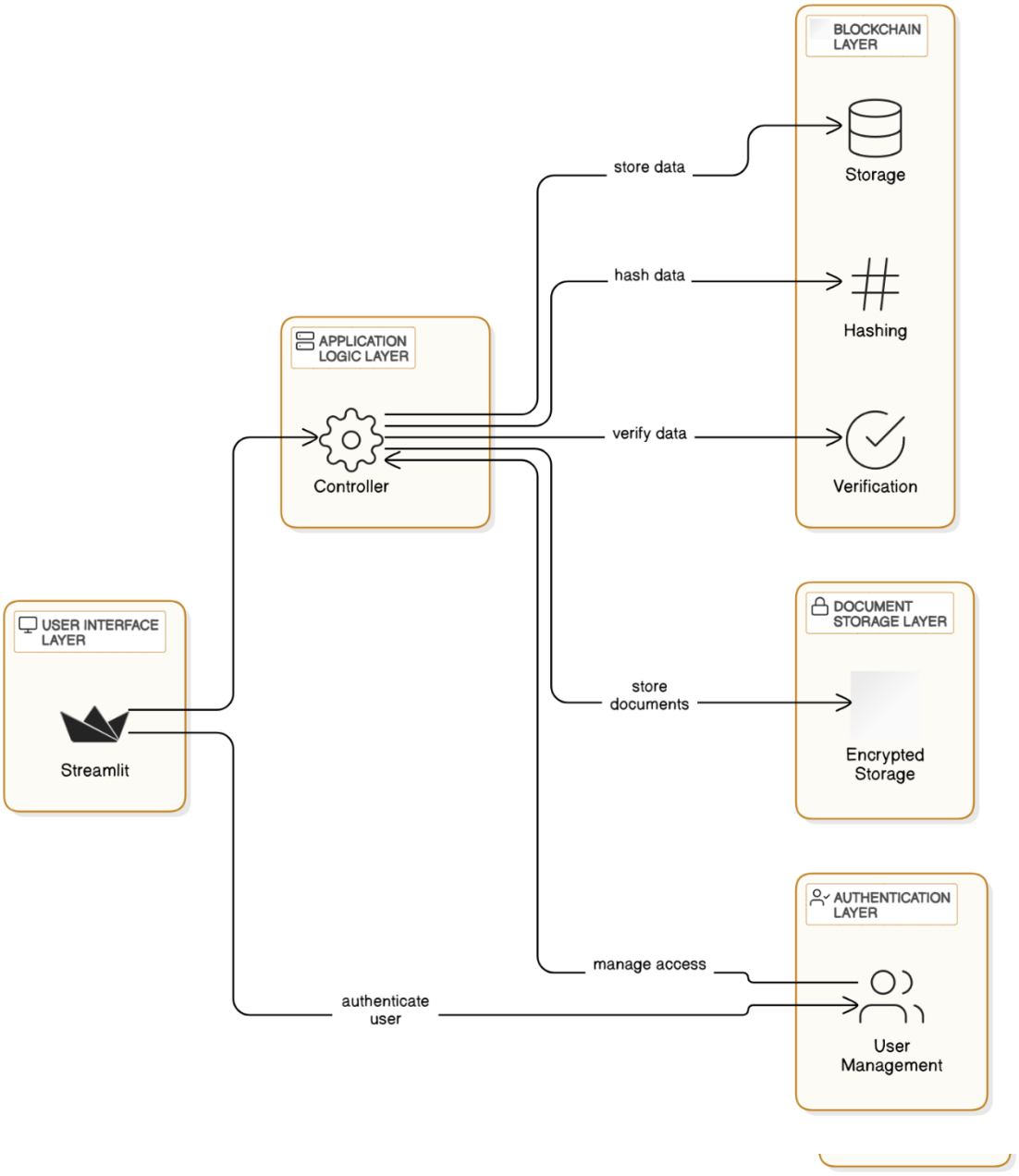

Figure 4.1.1: System Architecture Flowchart

4.2 Technical Specifications

Technical details of the E-vault system are as follows:

Backend: Python

Python is utilized in the backend with the benefit of supporting a large number of libraries and frameworks to achieve blockchain, encryption, and web development.

Blockchain: Custom Implementation

Custom light-weight blockchain implementation with Python that involves cryptographic hashing (SHA-256) and proof-of-work consensus algorithms.

Encryption: AES (Advanced Encryption Standard)

The files are encrypted with AES for confidentiality and security. The encryption key management is stored within the system securely.

Hashing: SHA-256

SHA-256 hashing is applied to enhance the integrity of documents.

The record is hashed and the hash maintaines on the blockchain establishing an irreversible, non-revisable account that can neither be changed or updates.

User Interface: Stream lit

The Stream lit is utilized to create the user interface, with a minimalistic and easy-to-use platform for interaction with the E-vault system. Stream lit supports fast web application development and deployment.

Database: SQLite (or any other lightweight database)

The database layer employs SQLite to store non-blockchain data, including user data and document metadata.SQLite is used due to its simplicity and ease of use.

Authentication: Salted Password Hashing

User authentication is managed through salted password hashing systems for storing user credentials securely.

Development Environment:

Operating System: Windows 11

IDE: Visual Studio Code

Python Version: 3.9 or higher

Dependencies:

streamlit: Used for creating the user interface

pycryptodome: Used for encryption and hashing

python-dotenv: Used for environment variable handling

Installation:

The setup and installation of the development environment include creating a virtual environment, installing dependencies necessary for installation, and installing the project structure according to the first setup guide of the project. After these technical specifications, the E-vault system offers a user-friendly, secure, and scalable environment for legal document management using blockchain technology.

Chapter 5

Methodology

The E-vault system aims to utilize blockchain technology for transparent and secure legal record management. The process for creating the E-vault system consists of several important steps: blockchain implementation, document management, user authentication, and interface design. Each of these steps is explained in the following detail.

Step 1: Blockchain Implementation

Goal: Create a light blockchain that is capable of recording securely transactions on document storage and transfer.

- **Blockchain Structure**: The blockchain is done in Python. Every block has an index, timestamp, array of transactions, previous block hash, current block hash, and a nonce value.
- **Hashing:** SHA-256 hashing is employed to hash every block's data so that even if there are some changes to the block data, it would become quite noticeable to do so.
- **Proof-of-Work:** A light-proof-of-work protocol is employed in order to attach blocks to the blockchain. Here, the process involves determining the nonce value that when combined with the data from the block together with prefixed count of leading zeros, would be produced by them.
- **Block Validation**: Validation of a new block is ensured by checking the hash of the previous block in order to keep the blockchain in its proper shape.

Step 2: Safe Document Storage

Objective: Keep documents safely via encryption and hashing.

- **Encryption:** The papers are encrypted with AES (Advanced Encryption Standard) before storage. This secures document content.
- **Hashing:** A paper is hashed with SHA-256 in order to acquire a fingerprint.The hash is kept on the blockchain for validation of the document's integrity.
- **Storage:** Local storage within the system stores data encrypted, and metadata (like hash) stored on the blockchain.

Step 3: User Authentication

Objective: Put in place a secure authentication mechanism for users to manage the access to the E-vault system.

- **User Registration:** User registration is possible by entering the password, email, and username.PASSWORDs are salted, followed by hashing and storage.
- **Login:** The user can log in using the username and password. The credentials are validated by comparing the stored hash with the hashed password.
- **Session Management:** Once the user is authenticated, they are given a session token to allow them to access the system securely.

Step 4: Document Management

- **Purpose**: Provide functionality for uploading, displaying, authenticating, and transferring files.
- **File Upload**: Uploading of files from the Streamlit interface is possible. The file is encrypted, hashed, and the encrypted file and information are stored.
- **File View:** Users can view their own uploaded files. The file is decrypted for viewing purposes and checks document integrity with stored hash.
- **Document Verification:** The authenticity of the documents can be verified by the users by comparing the present hash of the document with the hashed and saved document on the blockchain.
- **Document Transfer:** The documents can be transferred securely to other registered users.The transfer is documented as a transaction in the blockchain, resulting in a clear and irreversibly connected record.

Step 5: Interface Development

Objective: Create an accessible interface with Stream lit for use in interacting with the E-vault system.

- **Stream lit Interface:** The interface provides user registration capability, login, upload of documents, viewing documents, verification of documents, and transferring documents.
- **Blockchain Explorer:** It has an integrated blockchain explorer through which the user can see the transaction history on the blockchain and check the integrity of the blockchain.
- **User Interaction:** The system is designed intuitive and user-friendly such that the users can work with the system without needing huge technical knowledge.

Testing and Integration

Objective: Get everything to get along with one another and the system to act as intended.

1. **Unit Testing:** Every module (blockchain, encryption, authentication, document management) is tested separately in order to ensure proper functioning.
2. **Integration Testing:** The components are put together and end-to-end tests are performed to confirm all the pieces are working together as a system in harmony with each other.
3. **User Testing:** Users test the system in order to identify any usability issues and ensure that the interface is user-friendly and intuitive.

With this strategy, the E-vault system is developed to provide a secure, transparent, and user-friendly platform for storing legal documents through blockchain technology.

Chapter 6

Features and Functionalities

The E-vault system is designed to provide an entire suite of functionalities and features for facilitation of the secure, transparent, and efficient management of legal documents. The major functionalities and features of the E-vault system are enumerated as follows:

6.1 User Registration and Authentication

- **User Registration:** Makes it easy for new users with the ability to register by filling in a username, email address, and password. User accounts are also stored securely within the system with the use of salted password hashing methods to ensure safety procedures.
- **User Authentication:** Provides user logon by authenticating credentials. Session tokens are issued to users after successful authentication to allow secure communication to the system.
- **ROM-Based Access Control:** Offers access control to enable authenticated users to read or update some documents.

6.2 Secure Document Management

- **Document Upload:** Offers uploading of court documents. The application encrypts a document with AES, hashes it with SHA-256, and stores the encrypted document locally. Document metadata like the hash are stored on the blockchain to provide integrity.
- **Document Viewing:** Supports viewing of uploaded user documents. The system decrypts a document for viewing and checks its integrity against the hash stored.
- **Document Verification:** Offers functionality to make users capable of checking the integrity of their documents by comparing the document's hash in the blockchain with the document's current hash.
- **Document Transfer:** Enables secure transfer of ownership of documents to other registered users. Transfer is recorded as a transaction on the blockchain, and this has an open and immutable record.

6.3 Blockchain Explorer

- **Transaction History:** Enables users to see the entire history of transactions stored on the blockchain, such as document upload, transfers, and verification operations.

- **Block Details:** Supplies detailed information about every block of the blockchain, i.e., block index, timestamp, previous hash, current hash, nonce value, and list of transactions.
- **Blockchain Integrity:** Specifies blockchain integrity as valid and tamper-free or otherwise.

6.4 User Interface (Streamlit)

- **Dashboard:** Basic dashboard to display the user summary, i.e., recent document upload and document transfer.
- **Upload Document:** Simple upload document interface via which users can enter document information and upload documents.
- **My Documents:** A user page where users can see, authenticate, and transfer their uploaded documents.
- **Blockchain Explorer:** A built-in explorer of the blockchain where users can see transaction history and authenticate blockchain integrity.

6.5 Security Features

- **Encryption:** Performs AES encryption to secure stored documents from unauthorised access. Encryption keys applied are handled securely within the system.
- **Hashing:** Employs SHA-256 hashing to ensure integrity of documents. Each document's hash is kept on the blockchain, and any attempt at modification becomes traceable.
- **Session Management:** Ensures secure management of sessions to keep user interactions with the system secure.
- **Access Control:** Employing role-based access control to limit access to sensitive documents and functionality by roles.

6.6 Audit Trail

- **Immutable Records:** Offers an immutable audit record of all document-related activity, such as uploads, transfers, and verifications. This renders all action transparently logged and immutable.
- **Activity Logs:** Records complete histories of user activity such that administrators are able to monitor and audit system use.

Chapter 7

Implementation Details

The E-vault system is programmed using Python and Streamlit, driven by blockchain technology to store legal documents securely and transparently. The chapter provides an overview of how the application is to be installed, run, and executed, and instructions on how documents are to be stored and blockchain transactions conducted.

7.1 Setup Instructions

To get started with the E-vault system, follow these steps:

1. **Clone the Repository:**

   Clone the project repository from GitHub using the following command:sh

   - git clone https://github.com/Naveed-4/Block-Chain-Based-E-vault-for-Legal-Records.git
   - cd Block-Chain-Based-E-vault-for-Legal-Records

2. **Create a Virtual Environment:**

   - Create and activate a virtual environment for manage dependencies.

     python -m venv venv

   - Activate the virtual environment:
     - On Windows:sh

       venv\Scripts\activate

     - On macOS/Linux:sh

       source venv/bin/activate

3. **Install Dependencies:**

   Install dependencies listed in the requirements.txt file.sh

   - pip install -r requirements.txt

4. **Run the Application:**

   Run the Streamlit application using the following command:sh

   - streamlit run app.py

7.2 Usage Guide

Registration/Login:

- Go to the application in your web browser.
- Sign up for a new account by entering a username, email, and password, or sign in using current credentials.

Upload Documents:

- Click on the "Upload Document" page.
- Fill in the document details and choose the file you'd like to upload.
- Click on the "Save" button to save the document safely on the blockchain.

View Documents:

- Choose the "My Documents" page to view all your uploaded documents.
- Click the "View" button next to a document to view what it holds and the transaction history.

Transfer Documents:

- Click the "Transfer Document" page.
- Select the document to transfer and enter the recipient's username.
- Transfer the ownership of the document securely with blockchain.

Explore Blockchain:

- Utilize the application of the "Blockchain Explorer" feature to illustrate the blockchain structure and ensure its integrity.
- Present transaction and block information to provide transparency.

7.3 Checking Document Storage and Blockchain Transactions

Document Storage:

- AES-encrypted documents are locally stored in the storage directory.
- The document_storage.py application controls the document storage system such that documents are adequately encrypted before storage.

Blockchain Transactions:

- Blockchain transactions such as document uploads and transfers are regulated by the blockchain directory.
- The foundation blockchain classes exist in blockchain.py, and storage of blockchain data is in persistence.py.

- User authentication and transaction processing are handled by auth.py and evault_controller.py.

Files and Directories:

- **Main Application:** app.py
- **Blockchain Implementation:** blockchain/
  - blockchain.py: Core blockchain classes
  - persistence.py: Blockchain storage
  - auth.py: User authentication
  - evault_controller.py: Main controller
- **Document Storage:** storage/
  - document_storage.py: Document storage system
- **Dependencies:** requirements.txt

By following these steps, you can install and use the E-vault system, use the application through its user interface, and enjoy the secure storage and transfer of legal documents through the help of blockchain technology.

Chapter 8

Results

Figures 8.1 to 8.11 are the screenshots of project in run using stream lit in localhost with description of the figure.

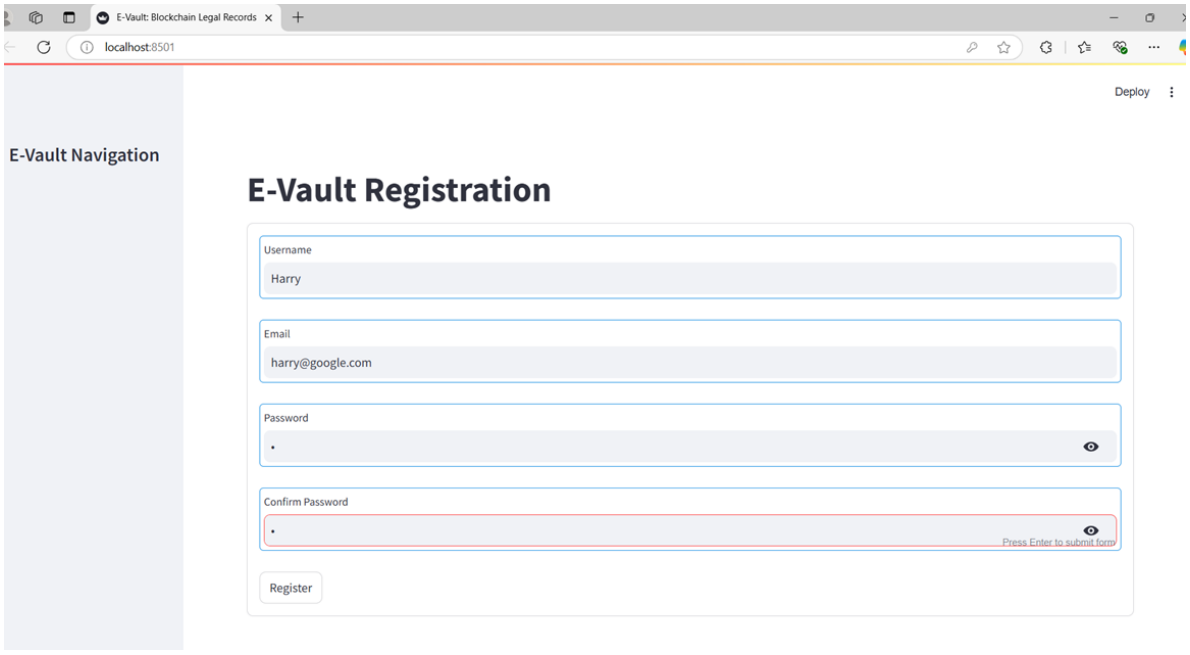

Figure 8.1: Landing Page

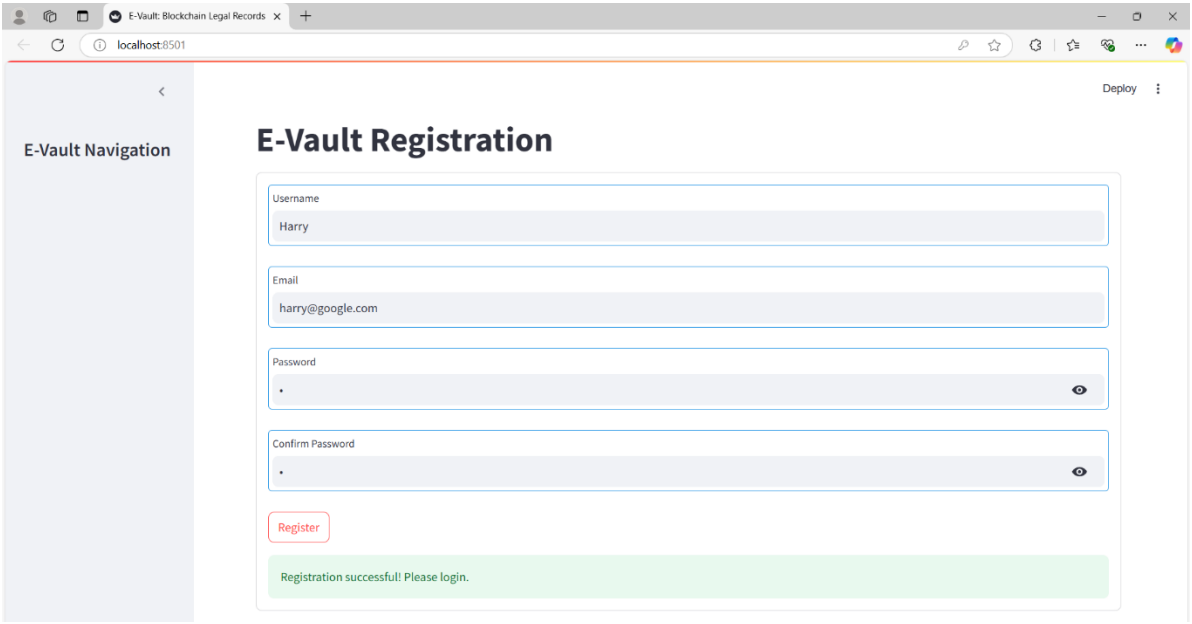

Figure 8.2: Registration Page: Harry registered

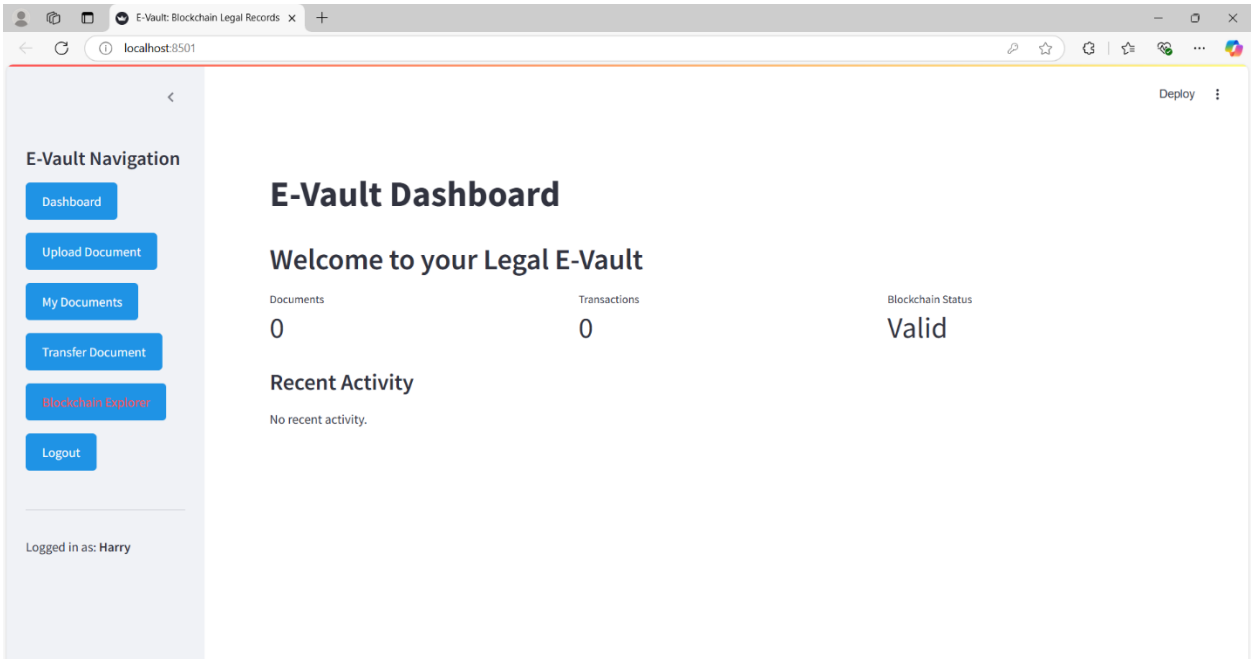

Figure 8.3: Initial Dashboard: Harry

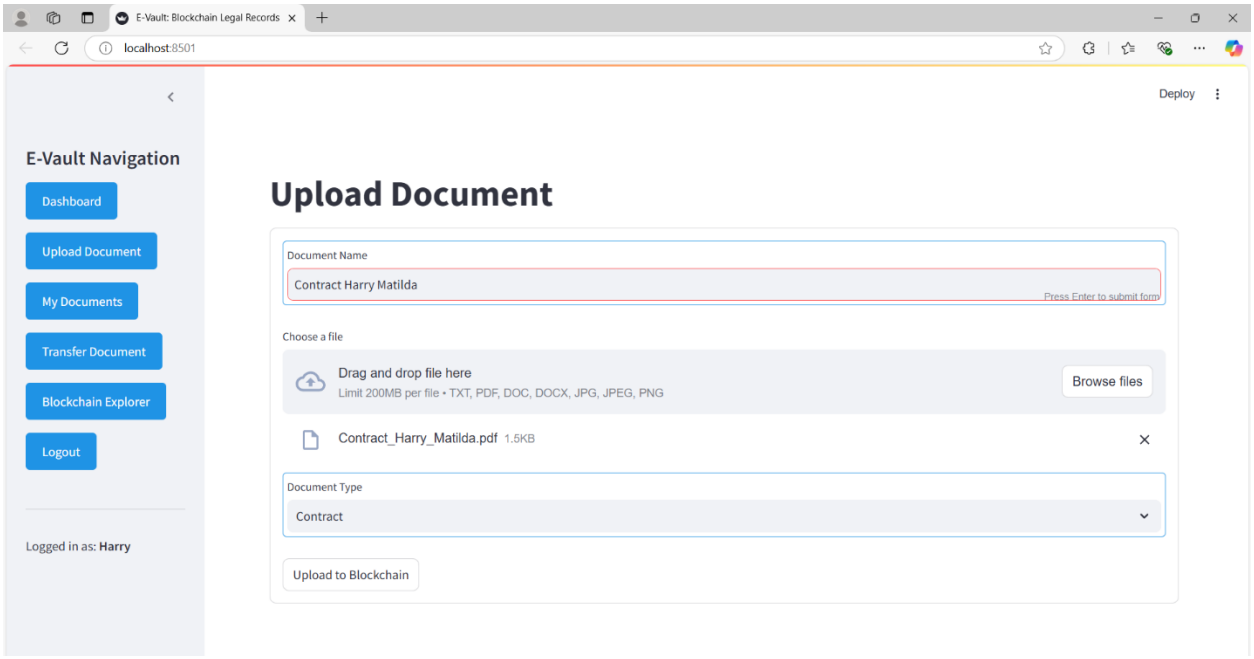

Figure 8.4: Uploading Document\Contract: Harry

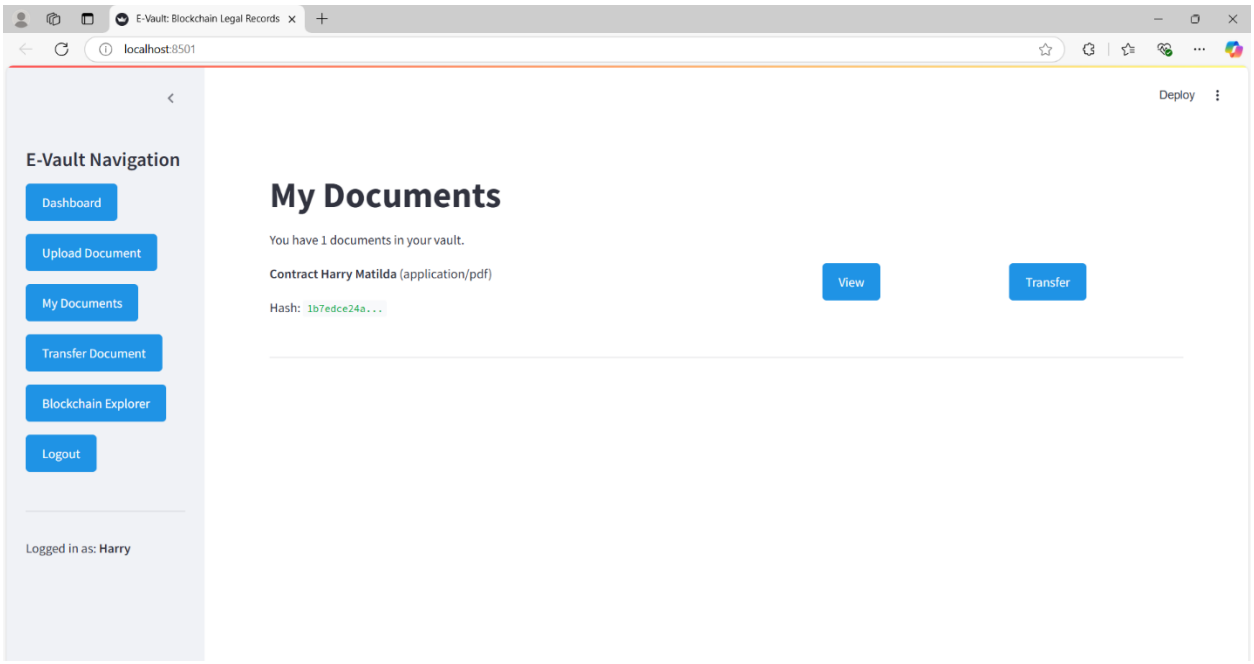

Figure 8.5: My Documents Page: Harry

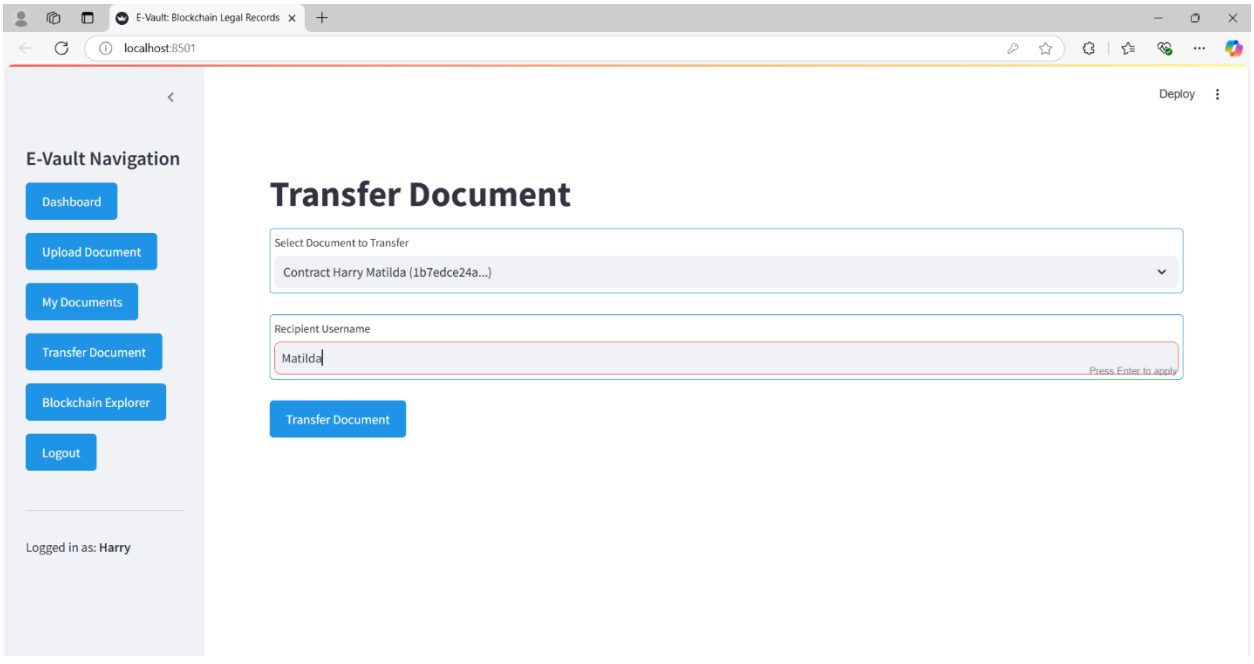

Figure 8.6: Transfer Document: Harry transferring to Matilda

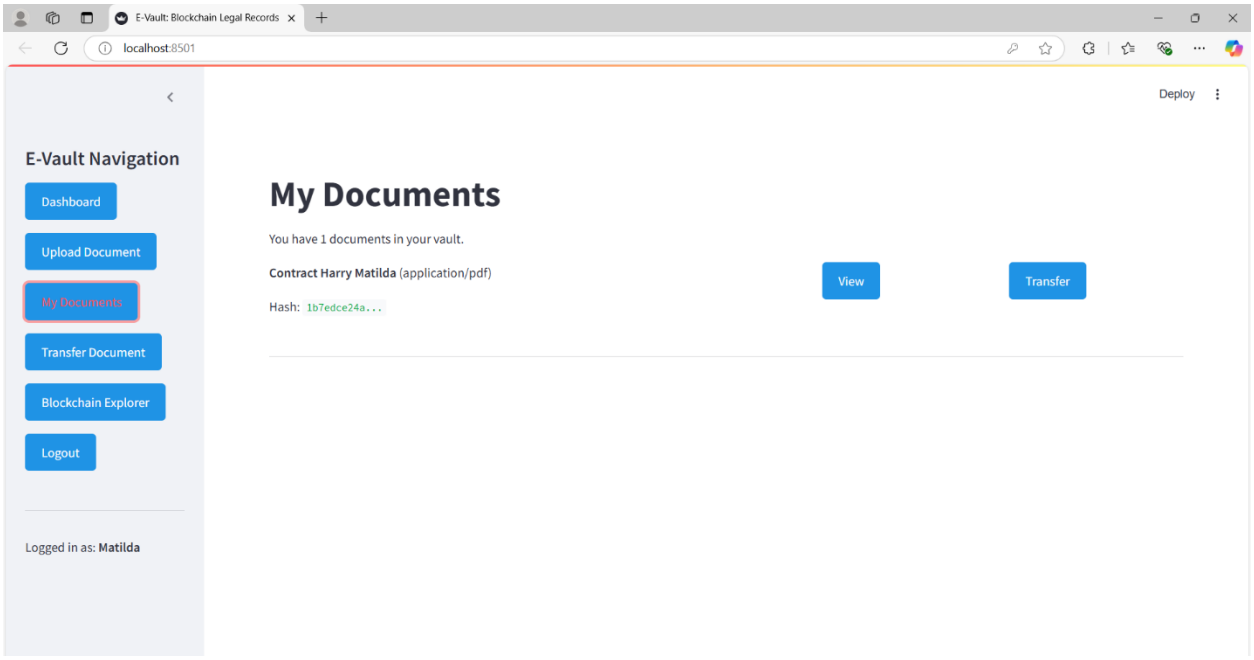

Figure 8.7: My Documents Page: Matilda –User 2. File Transferred

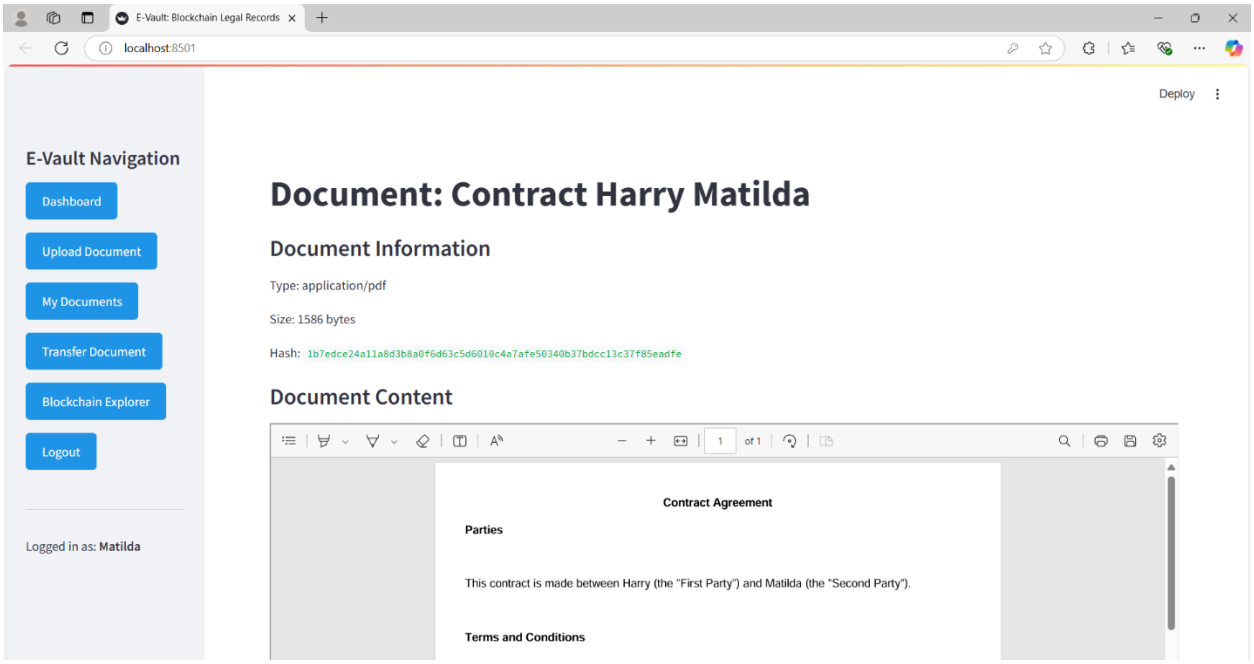

Figure 8.8: Viewing the Document: Matilda –User 2.

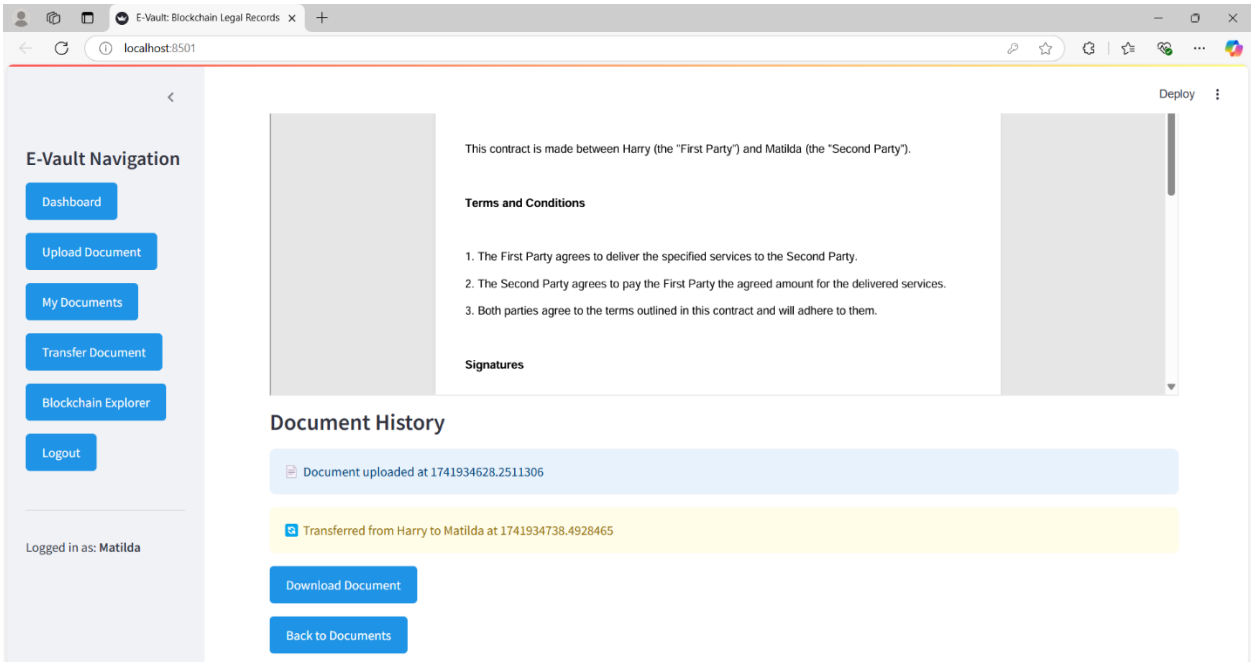

Figure 8.9: Document History is shown below while viewing the document: Matilda –User 2.

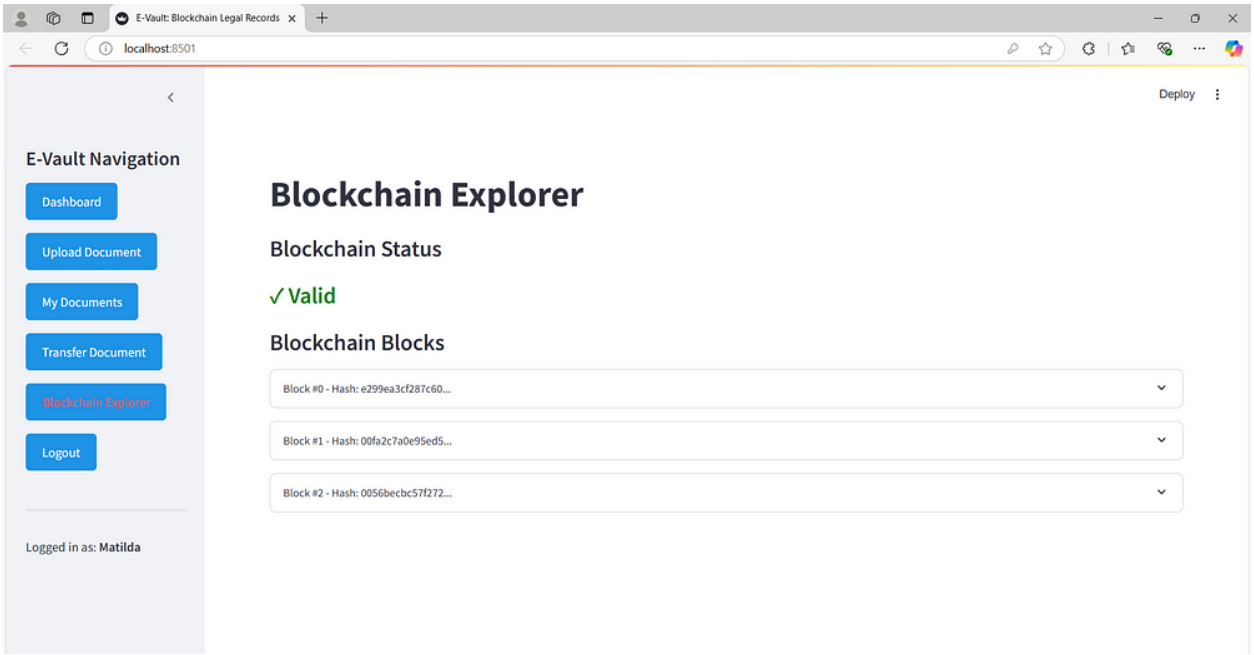

Figure 8.10: Blockchain Explorer Page

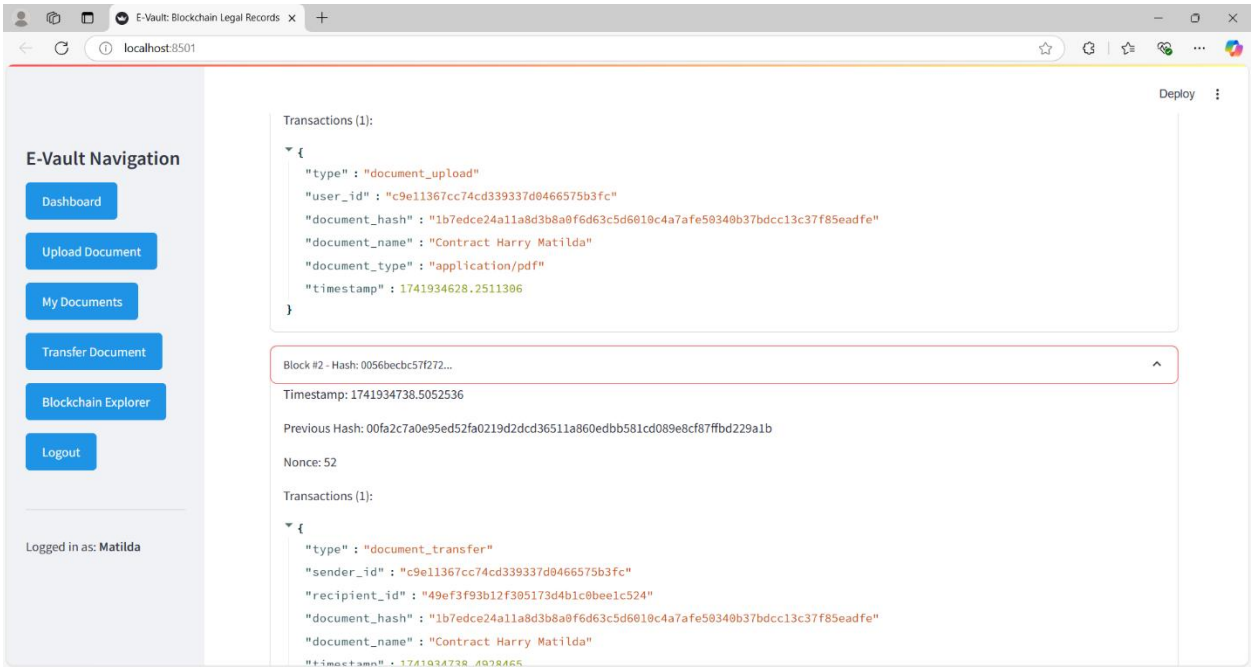

Figure 8.11: Blockchain explorer: Tracks all transactions

Figures 8.12 to 8.14 are the screenshots of document storage structure generated after running the application with Description of the figure.

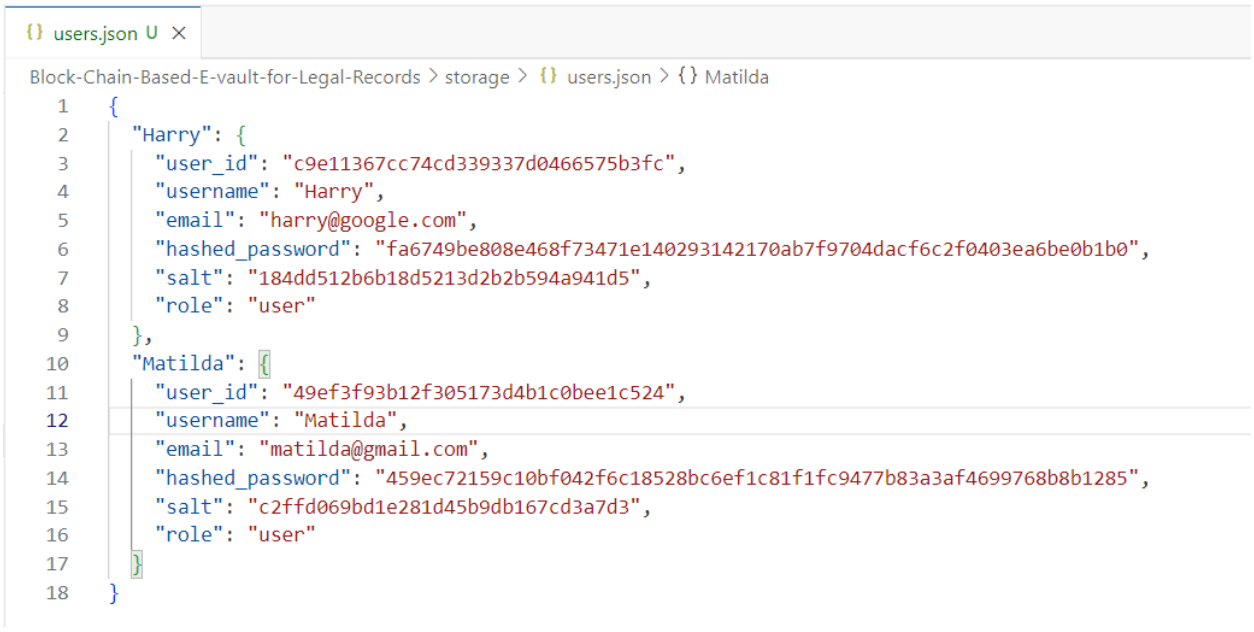

Figure 8.12: Users Info: Harry and Matilda

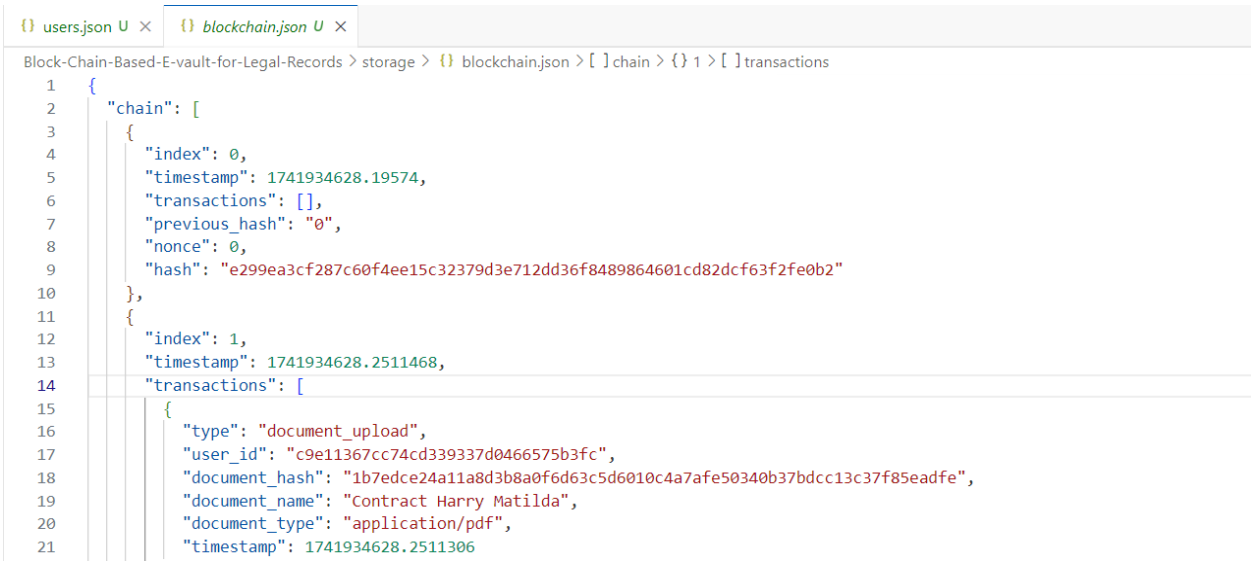

Figure 8.13: Blockchain: All Transactions are tracked

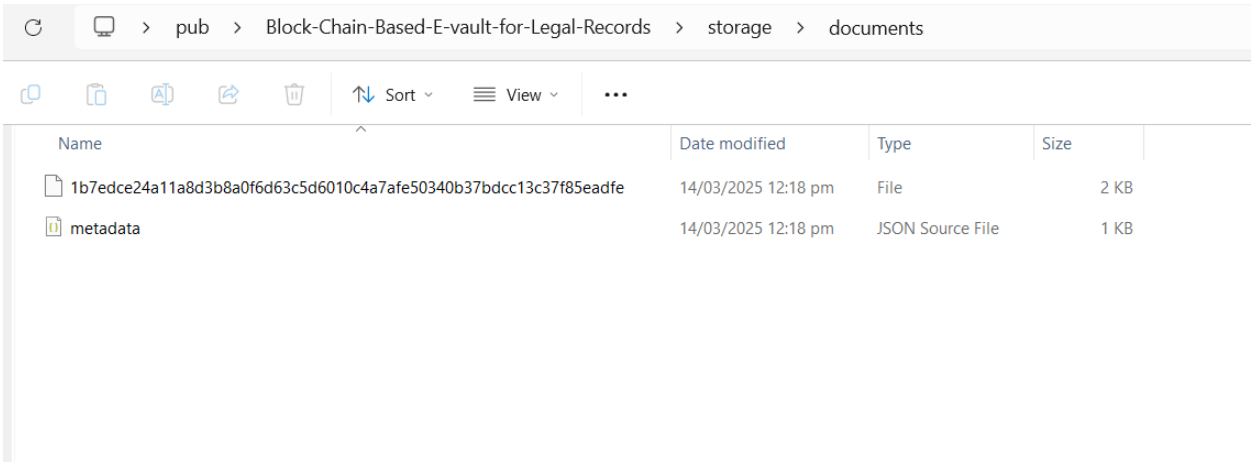

Figure 8.14: Documents Stored as Encrypted

Chapter 9

Challenges and Solutions

9.1 Challenge: Ensuring Document Integrity and Security

Problem: Integrity and security of legal documents are of the utmost importance. Traditional systems are vulnerable to tampering and unauthorized access, which can render the authenticity and confidentiality of legal documents useless.

Solution:

- **Blockchain Technology:** By leveraging blockchain's immutable ledger, we ensure that any tampering with documents is easily detectable. Each document's hash is stored on the blockchain, providing a verifiable proof of integrity.
- **AES Encryption:** Documents are encrypted using AES before storage, ensuring that only authorized users can access the document contents.
- **SHA-256 Hashing:** SHA-256 hashing is applied to each document to create a one-of-a-kind fingerprint. The hash is subsequently stored on the blockchain, creating an indelible history of the document.

9.2 Challenge: Document Ownership and Transfer Management

Problem: Traditional systems use primarily manual document transfer processes, which are slow and prone to errors.

Solution:

- Automated and Secure Transfers of Ownership: Automated and secure transfers of ownership of documents are enabled by E-vault system through blockchain transactions. It is done in a manner to promote accuracy and efficiency with lesser space for error.
- Open Record of Transfer: The whole record of transfer is made in the blockchain, hence an open and non-falsifiable record of document ownership. Users can now see a record of transfer history and confirm ownership records.

9.3 Challenge: System Usability and Accessibility

Problem: Blockchain technology is intricate and intimidating for the general user to operate and understand.

Solution:

- **Streamlit Interface:** The E-vault system employs Streamlit to offer an interface. This is granting access with the blockchain system and is simple for legal professionals to access without requiring knowledge that is of a higher caliber.
- **Intuitive Design:** The interface is easy to understand and utilize workflows for uploading documents, viewing, verification, and transfer. It is convenient for the user and enables users to accomplish tasks on time required.

9.4 Challenge: Scalability and Performance

Problem: The greater the number of documents and transactions, the greater the system load with the more complex work without the degradation of performance.

Solution:

- **Lightweight Blockchain Implementation:** The lightweight blockchain implementation is efficiency- and performance-oriented, enabling the system to support a large volume of transactions without redundant delays.
- **Efficient Storage:** Blockchain information and encrypted files are stored with efficient storage mechanisms, allowing rapid retrieval and processing of information.
- **Modular Structure:** Modularity within the E-vault system enables simple maintenance and scalability. One module can be added or modified separately without affecting the remainder of the system, and thus the system expands and develops but doesn't change the entire system.

With such specially tailored solutions to such problems, the E-vault system provides a secure, efficient, and easy-to-use platform for the management of legal documents through the use of blockchain technology.

Chapter 10

Conclusion and Future Scope

10.1 Conclusion

The "E-vault Using Blockchain for Secure Storage and Transfer of Legal Documents" project is an illustration of the capability of blockchain technology to revolutionize the management of legal documents. With blockchain, advanced encryption techniques, and easy-to-use interface, the E vault system addresses critical challenges characteristic of conventional document management systems, including the integrity, security, transparency, and efficiency of documents. The highest achievements of the project are:

- **Safe Storage of Documents:** AES encryption provides the security of documents, and SHA-256 hashing provides their integrity.
- **Immutable Audit Trail:** The blockchain has an open and immutable audit trail for every document transaction, such as upload, transfer, and verification.
- **Automatic Transfer of Ownership:** The process facilitates safe and automatic transfer of ownership of documents free from error and time.
- **Simple User Interface:** The user interface based on Streamlit is simple for legal professionals to utilize, and they can use the blockchain without necessarily knowing the back-end data.
- **Improved Security:** Being decentralized, the blockchain reduces the number of points of failure and secures the system as a whole.

In all, the E-vault system is an economic and cost-saving legal record retention solution that has auditable, tamper-evident records and access security.

10.2 Future Scope

The E-vault system is a solid ground where documents can be placed, but there are numerous areas where development and expansion could be incorporated:

- **Smart Contracts:** Smart contracts can be incorporated into the system in a bid to computerize legal sophistications like rule-based document exchange and condition-based access control. This would add even more functionality and efficiency in the system.

- **Biometric Authentication:** Biometric authentication systems like fingerprint recognition or face recognition can also make user authentication and security more convenient.
- **Mobile Interface:** It would be possible for the users of the E-vault system to be online in real time with the development of a mobile app, and the system would be more user-friendly and convenient.
- **Interoperability with Other Systems:** The system can also be interfaced with other legal and document management systems in a standardized manner through APIs so that data can be merged or shared seamlessly.
- **Scalability Upgrades:** Upgrading the blockchain deployment to accommodate even larger volumes of documents and transactions as the system expands in size.
- **Forward-looking Reporting:** Incorporating forward-looking reporting and analytics functionality to provide insights into document usage, transferal trends, and system performance.
- **Compliance with the Law:** Assuring compliance with future legal and regulatory requirements for data protection, privacy, and electronic signatures.

Through such prospects for future growth, the E-vault system can further expand and evolve to accommodate the developments that are needed in the practice of law, providing an extensive and secure legal document management solution.

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Software and Libraries

1. **Python:** General-purpose programming language used for the entire project.
2. **Streamlit:** Web app framework for developing the user interface. Documentation**:** https://docs.streamlit.io/
3. **PyCryptodome:** Library for cryptographic operations, including AES encryption and SHA-256 hashing. Documentation: https://www.pycryptodome.org/
4. **SQLite:** Lightweight database for storing user information and document metadata.

GitHub Repository: https://github.com/Naveed-4/Block-Chain-Based-E-vault-for-Legal-Records