

Team: 55

BLOCK CHAIN BASED E-VAULT FOR LEGAL RECORDS

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Abstract

This project implements a secure blockchain-based vault system for legal document storage, verification, and transfer. Leveraging immutable distributed ledger technology with local encryption, E-Vault ensures tamper-proof document integrity while providing a user-friendly interface. The system addresses critical challenges in legal record management through cryptographic validation, transparent audit trails, and secure ownership transfer mechanisms.

Introduction

E-vault is a blockchain-based solution designed to address the critical need for secure and transparent management of legal records. By leveraging distributed ledger technology, the system ensures document immutability and traceability while providing an intuitive user experience. The project demonstrates how blockchain can be practically applied to legal record management, offering enhanced security and trust compared to traditional centralized systems.

Motivation

The legal industry faces significant challenges with document security, integrity verification, and establishing clear chains of custody. Traditional systems often struggle with:

- Ensuring documents haven't been tampered with
- Providing verifiable proof of document ownership
- Creating transparent transfer histories
- Maintaining document integrity over time

E-vault addresses these challenges by implementing blockchain technology as a foundation for secure legal record management.

Literature Review

Blockchain Applications in Document Management

Blockchain technology has emerged as a promising solution for document management systems. Zheng et al. (2018)[1] highlight blockchain's immutability and distributed consensus as key features for ensuring document integrity. However, they note scalability challenges when handling large document volumes. Hash-based verification techniques, as proposed by Wang et al. (2020),[2] enable document validation without revealing sensitive content, particularly valuable for legal records where confidentiality is paramount.

Literature Review

Advancements in Legal Document Systems

Recent developments have focused on enhancing document transfer mechanisms. Kumar and Smith (2022)[3] introduced a blockchain-based transfer protocol with multi-signature authorization to ensure secure document custody changes.

Meanwhile, Chen et al. (2021)[4] addressed privacy concerns through zero-knowledge proofs, allowing document verification without revealing underlying data. These approaches, while effective, often require complex infrastructures. Our work builds upon these foundations while prioritizing simplicity and accessibility through a streamlined user interface and localized implementation.

Existing Method v/s Proposed Method

Traditional document management systems rely on centralized authorities and databases, creating single points of failure and requiring trust in system administrators. Our proposed E-vault solution leverages blockchain technology to distribute trust across the network, ensuring documents cannot be altered without detection. The system uses cryptographic hashing for document verification and smart contract principles for secure ownership transfer, creating a tamper-evident audit trail for all document transactions.

Existing Method v/s Proposed Method

Table 1: Existing v/s Proposed methods

Feature	Traditional Systems	Cloud-Based Systems	E-Vault Blockchain
Tamper Resistance	Low	Medium	High
Data Ownership	Service Provider	Service Provider	User
Verification	Manual	Digital Signatures	Cryptographic Proof
Transfer Security	Low	Medium	High
Audit Trail	Limited	Centralized Logs	Immutable Record
Implementation	Complex	Moderate	Simple Local Setup
Cost	High Maintenance	Subscription-Based	One-time Setup

Existing Method v/s Proposed Method

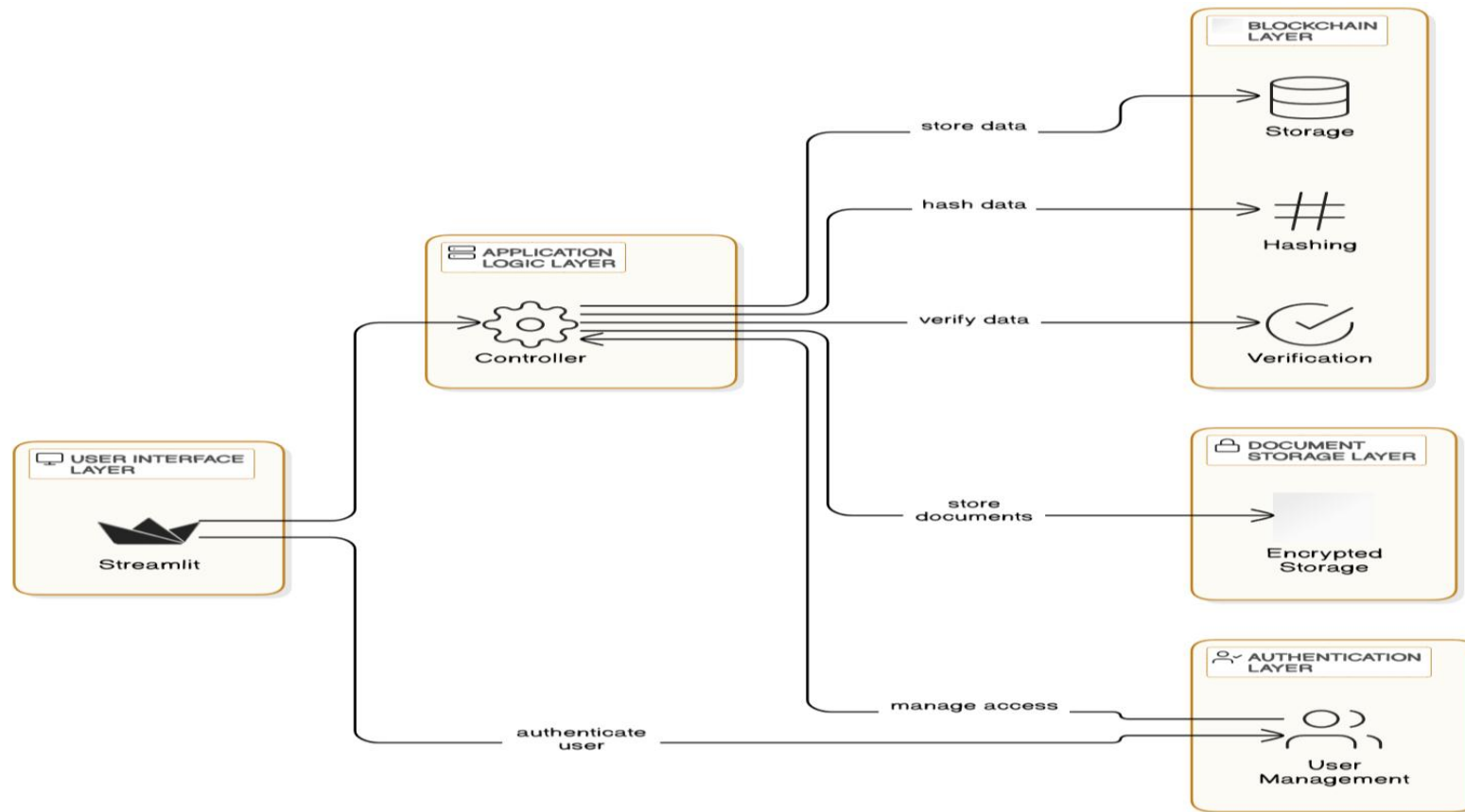


Figure 1: Proposed plan

Objective

Primary Goal: To develop a secure, blockchain-based system for storing and transferring legal records that ensures document integrity, ownership verification, and transparent history tracking.

Sub-Goals:

- Implement a lightweight blockchain solution for document verification using cryptographic hashing and proof-of-work
- Create a secure document storage system with encryption and access control mechanisms
- Develop a transparent document transfer mechanism with immutable ownership history
- Build a user-friendly interface using Streamlit to make blockchain technology accessible to legal professionals
- Establish a comprehensive audit trail for all document activities

Document Storage Structure

Our system manages multiple data structures:

- **User Records:** Authentication credentials and access permissions
- **Document Metadata:** Name, type, ownership, timestamps, and access history
- **Document Content:** Encrypted binary data with secure storage
- **Blockchain Records:** Transaction history, validation hashes, and proof-of-work
- **Session Data:** Temporary authentication tokens and user state

Document Storage Structure

```
{} users.json U X
Block-Chain-Based-E-vault-for-Legal-Records > storage > {} users.json > {} Matilda
1  {
2    "Harry": {
3      "user_id": "c9e11367cc74cd339337d0466575b3fc",
4      "username": "Harry",
5      "email": "harry@google.com",
6      "hashed_password": "fa6749be808e468f73471e140293142170ab7f9704dacf6c2f0403ea6be0b1b0",
7      "salt": "184dd512b6b18d5213d2b2b594a941d5",
8      "role": "user"
9    },
10   "Matilda": {
11     "user_id": "49ef3f93b12f305173d4b1c0bee1c524",
12     "username": "Matilda",
13     "email": "matilda@gmail.com",
14     "hashed_password": "459ec72159c10bf042f6c18528bc6ef1c81f1fc9477b83a3af4699768b8b1285",
15     "salt": "c2ffd069bd1e281d45b9db167cd3a7d3",
16     "role": "user"
17   }
18 }
```

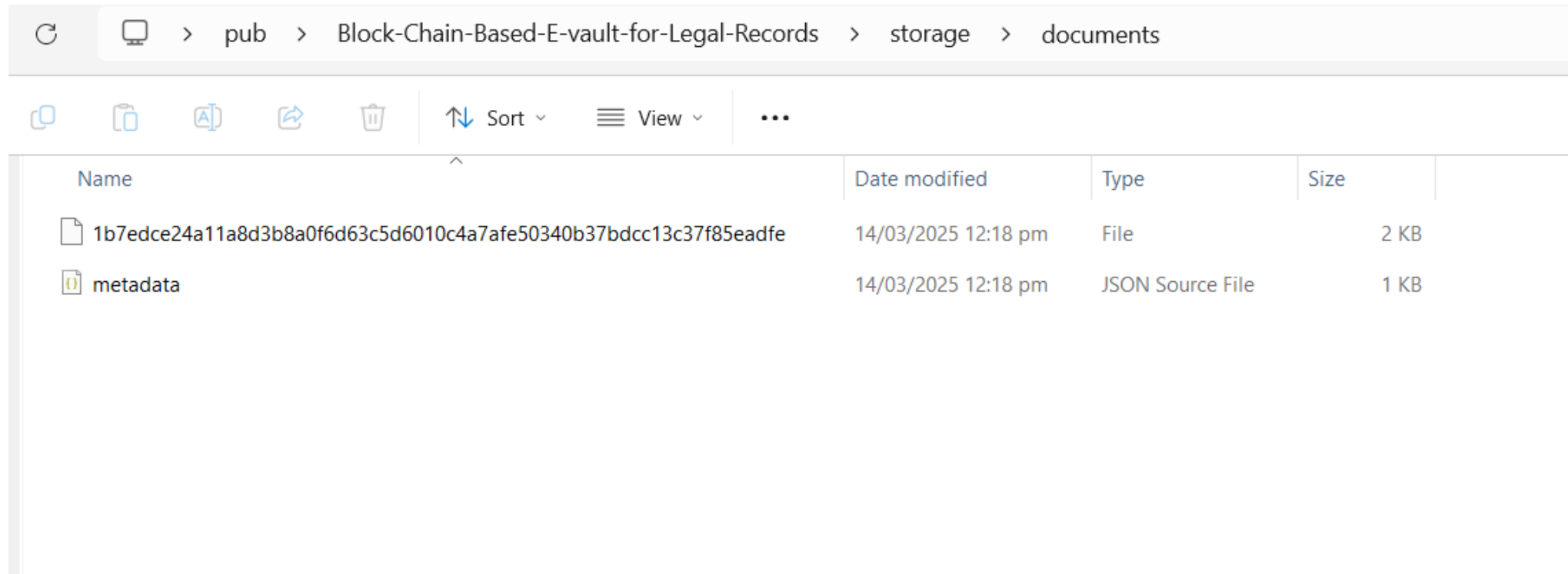
Figure 2: Users Info: Harry and Matilda

Document Storage Structure

```
{} users.json U × {} blockchain.json U ×
Block-Chain-Based-E-vault-for-Legal-Records > storage > {} blockchain.json > [ ] chain > {} 1 > [ ] transactions
1 {
2   "chain": [
3     {
4       "index": 0,
5       "timestamp": 1741934628.19574,
6       "transactions": [],
7       "previous_hash": "0",
8       "nonce": 0,
9       "hash": "e299ea3cf287c60f4ee15c32379d3e712dd36f8489864601cd82dcf63f2fe0b2"
10    },
11    {
12      "index": 1,
13      "timestamp": 1741934628.2511468,
14      "transactions": [
15        {
16          "type": "document_upload",
17          "user_id": "c9e11367cc74cd339337d0466575b3fc",
18          "document_hash": "1b7edce24a11a8d3b8a0f6d63c5d6010c4a7afe50340b37bdcc13c37f85eadfe",
19          "document_name": "Contract Harry Matilda",
20          "document_type": "application/pdf",
21          "timestamp": 1741934628.2511306
```

Figure 3: Blockchain: All Transactions are tracked

Document Storage Structure



The image shows a file explorer interface with a breadcrumb path: > pub > Block-Chain-Based-E-vault-for-Legal-Records > storage > documents. Below the path is a toolbar with icons for copy, paste, rename, share, delete, sort, view, and a menu. The main area displays a table of files.



Name	Date modified	Type	Size
 1b7edce24a11a8d3b8a0f6d63c5d6010c4a7afe50340b37bdcc13c37f85eadfe	14/03/2025 12:18 pm	File	2 KB
 metadata	14/03/2025 12:18 pm	JSON Source File	1 KB

Figure 4: Documents Stored as Encrypted

Methodology: Technical Implementation Approach

1.Blockchain Core Development:

1. Custom Python implementation with proof-of-work consensus
2. Block structure with transaction batching and hash validation

2.Document Management:

1. AES encryption for document security
2. Hash-based verification for content integrity
3. Segregated storage for metadata and encrypted content

3.User Interface:

1. Streamlit-based responsive design
2. Session-based authentication with token validation
3. Intuitive document upload, view, and transfer workflows

RESULTS:

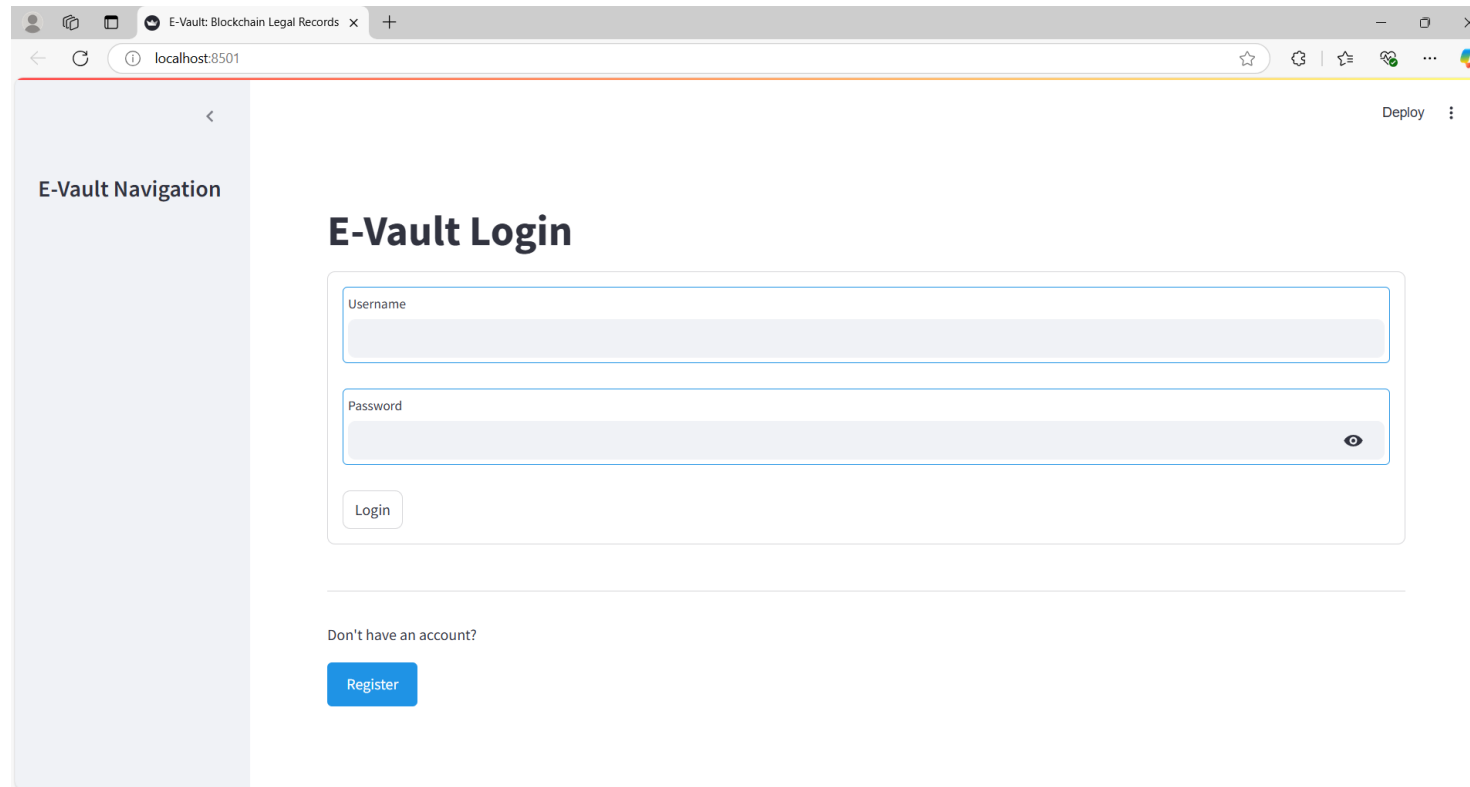
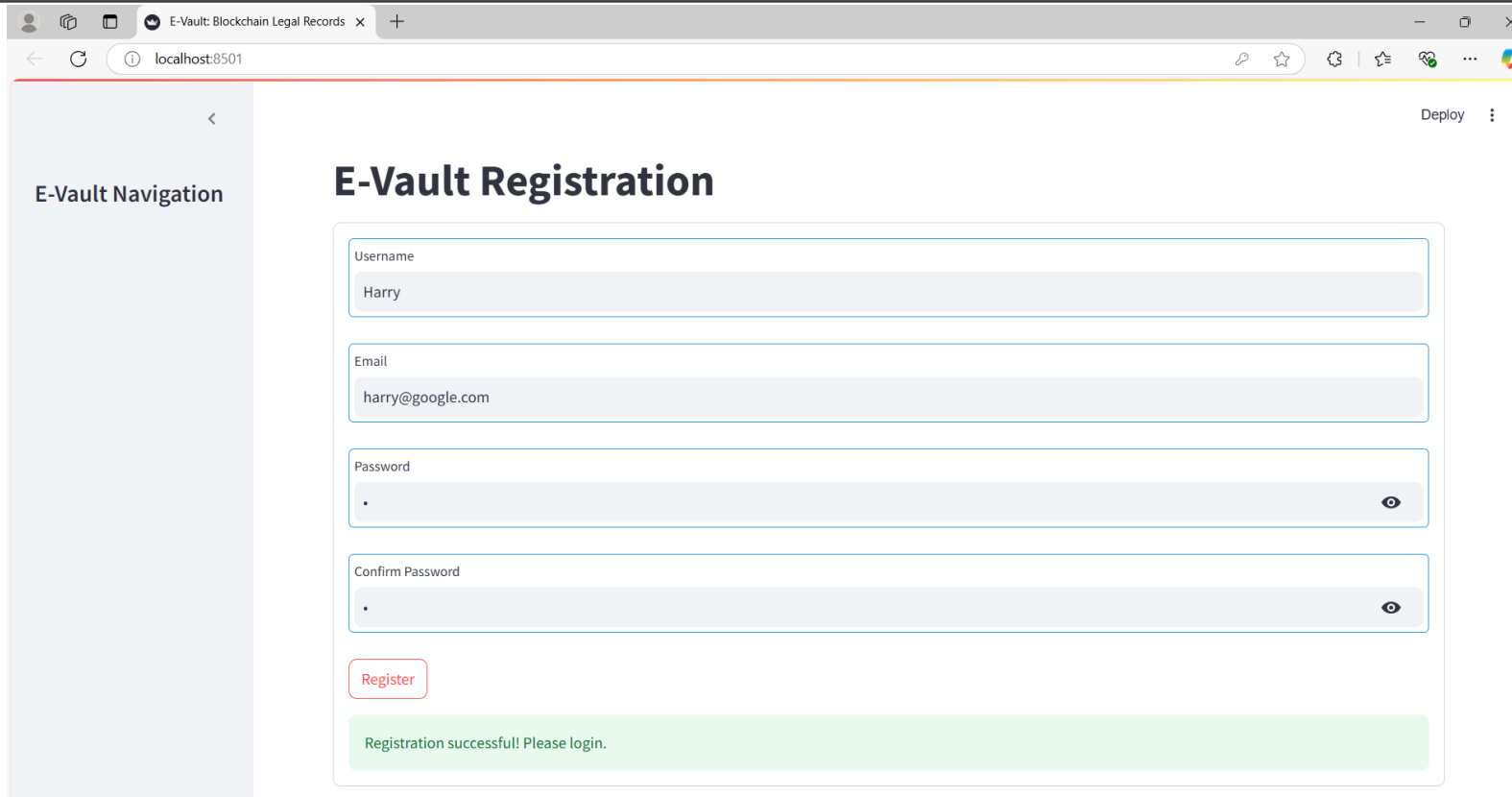


Figure 5: Landing Page

RESULTS:



The screenshot displays a web browser window with the address bar showing 'localhost:8501'. The page title is 'E-Vault: Blockchain Legal Records'. The main content area is titled 'E-Vault Registration' and contains a registration form. The form has four input fields: 'Username' (containing 'Harry'), 'Email' (containing 'harry@google.com'), 'Password' (containing a masked password), and 'Confirm Password' (containing a masked password). Below the form is a red 'Register' button. A green message box at the bottom of the form states 'Registration successful! Please login.'.

E-Vault Navigation

E-Vault Registration

Username
Harry

Email
harry@google.com

Password
•

Confirm Password
•

Register

Registration successful! Please login.

Figure 6: Registration Page: Harry registered

RESULTS:

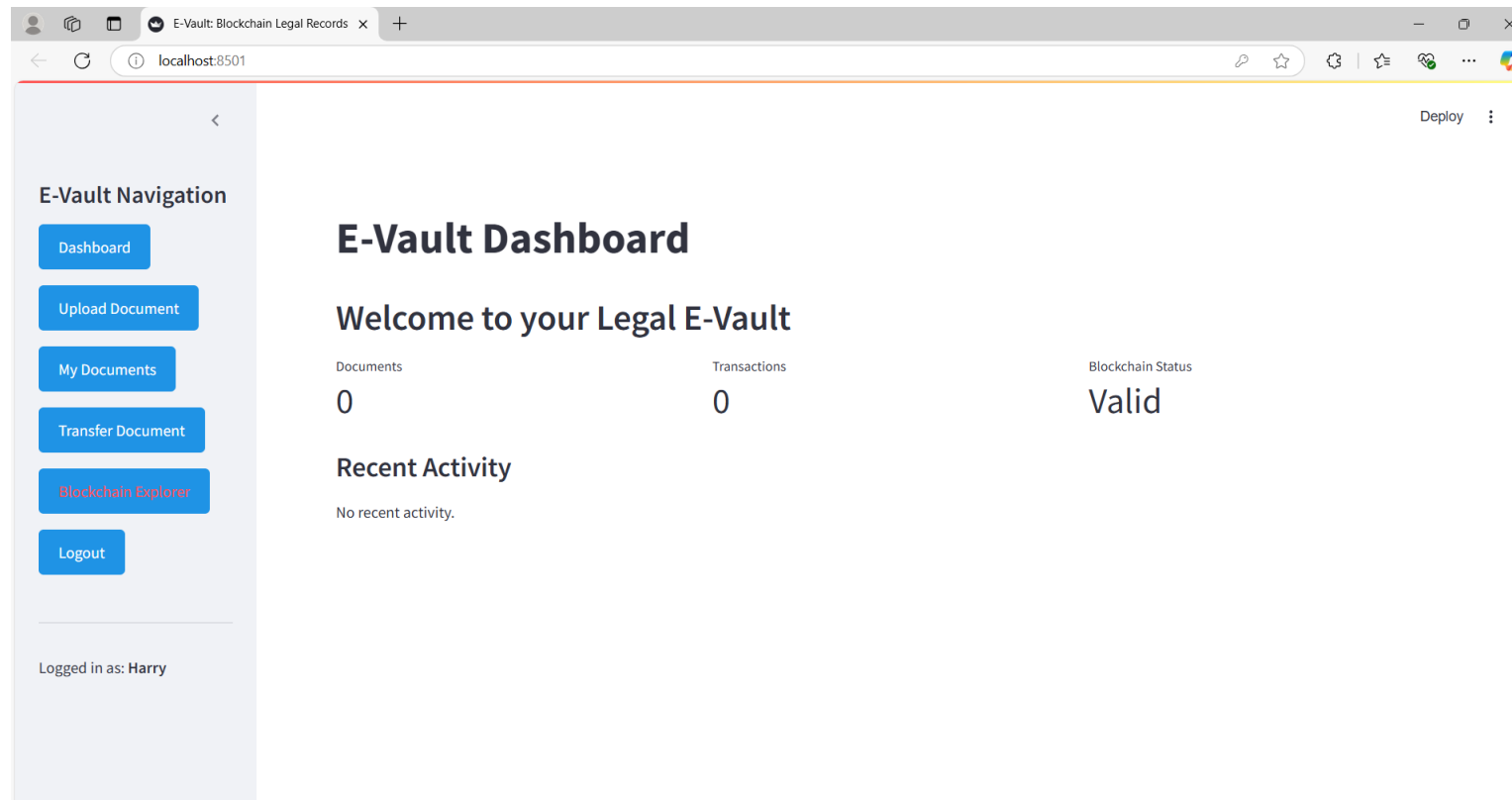


Figure 7: Initial Dashboard: Harry

RESULTS:

E-Vault: Blockchain Legal Records x +

localhost:8501

Deploy

E-Vault Navigation

- Dashboard
- Upload Document
- My Documents
- Transfer Document
- Blockchain Explorer
- Logout

Logged in as: Harry

Upload Document

Document Name

Contract Harry Matilda Press Enter to submit form

Choose a file

Drag and drop file here
Limit 200MB per file • TXT, PDF, DOC, DOCX, JPG, JPEG, PNG

Browse files

Contract_Harry_Matilda.pdf 1.5KB

Document Type

Contract

Upload to Blockchain

Figure 8: Uploading Document\Contract: Harry

RESULTS:

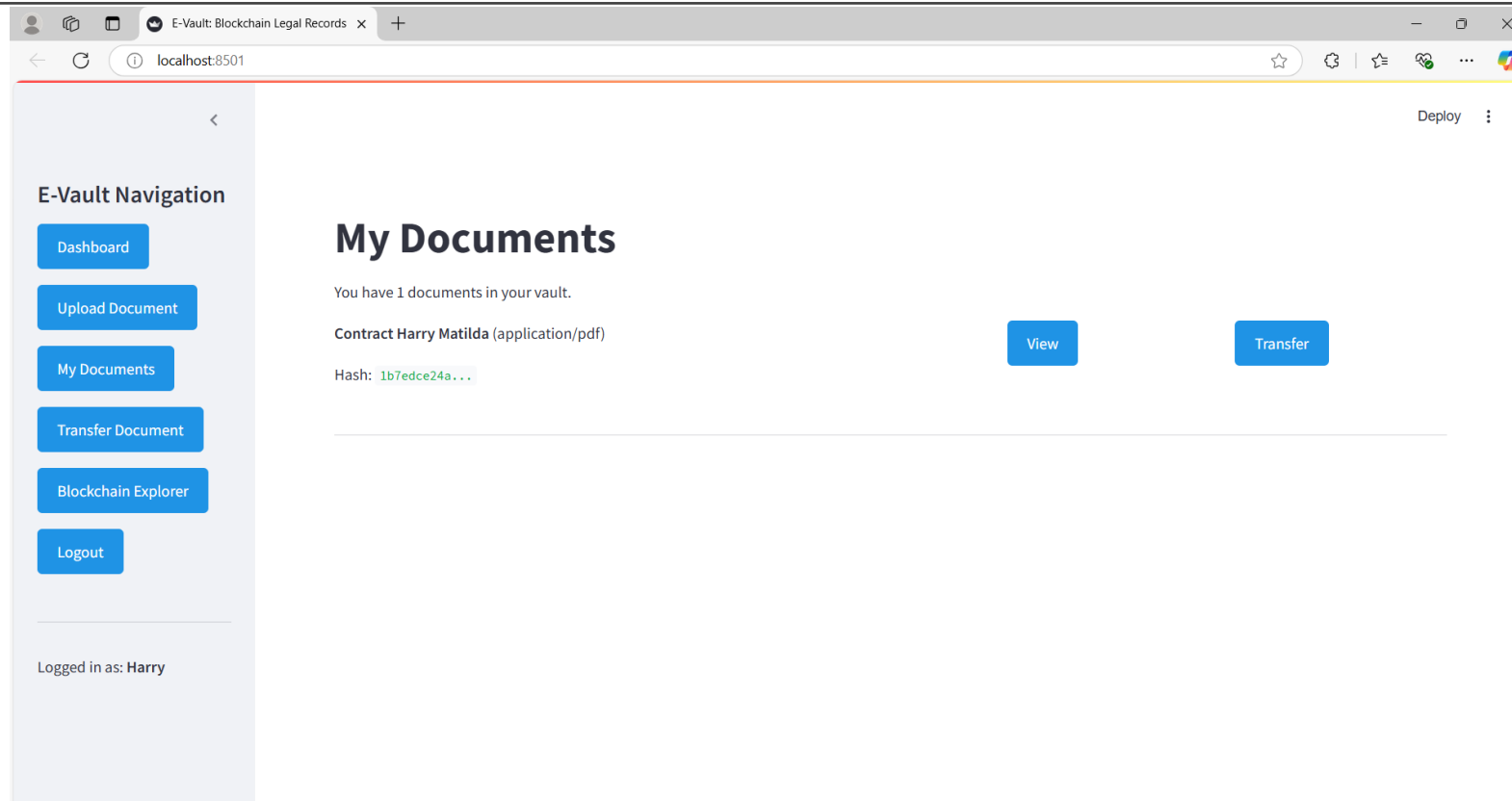


Figure 9: My Documents Page: Harry

RESULTS:

E-Vault: Blockchain Legal Records x +

localhost:8501

Deploy

E-Vault Navigation

- Dashboard
- Upload Document
- My Documents
- Transfer Document
- Blockchain Explorer
- Logout

Logged in as: Harry

Transfer Document

Select Document to Transfer

Contract Harry Matilda (1b7edce24a...)

Recipient Username

Matilda

Press Enter to apply

Transfer Document

Figure 10: Transfer Document: Harry transferring to Matilda

RESULTS:

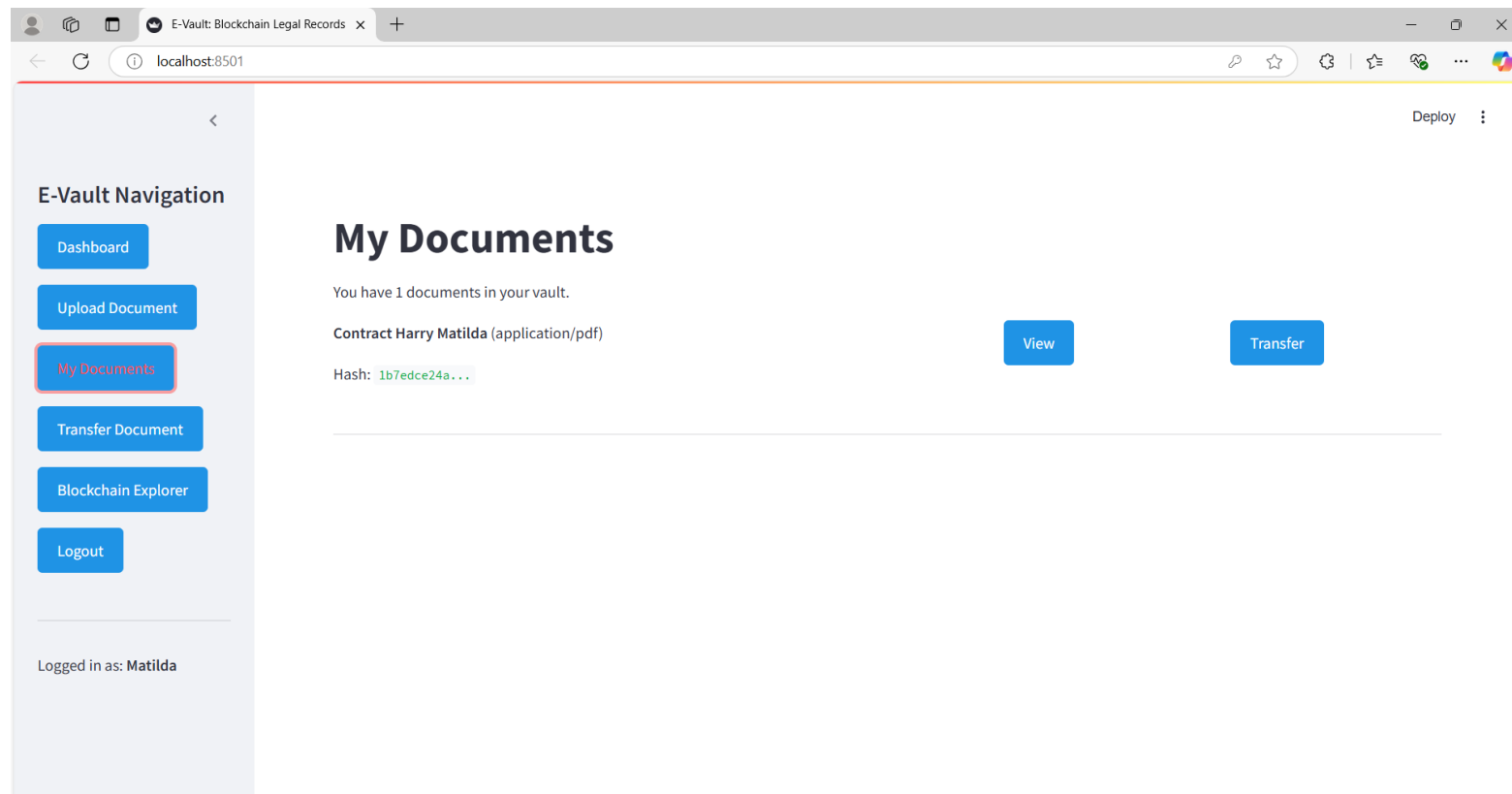


Figure 11: My Documents Page: Matilda –User 2. File Transferred

RESULTS:

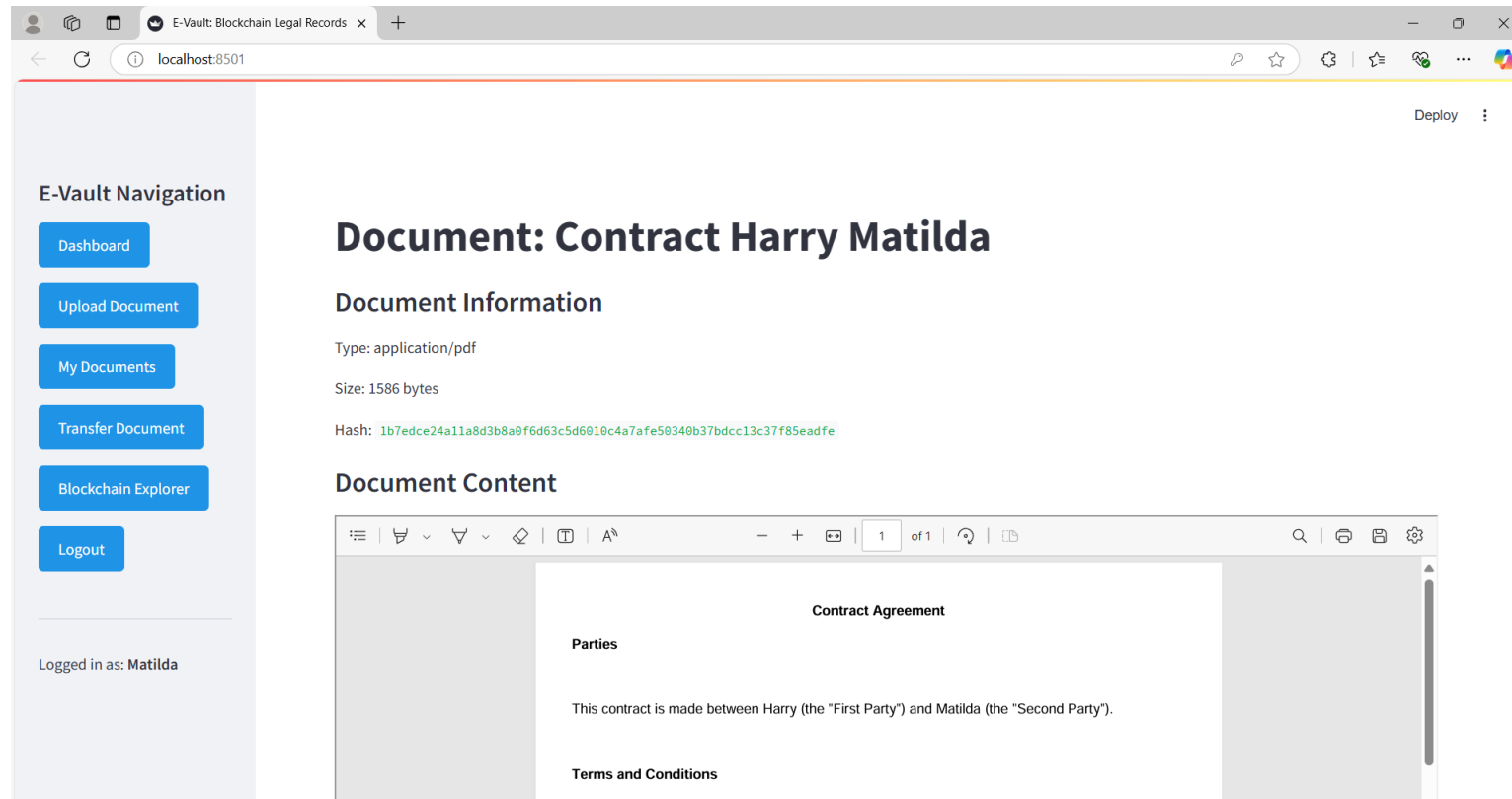


Figure 12: Viewing the Document: Matilda –User 2.

RESULTS:

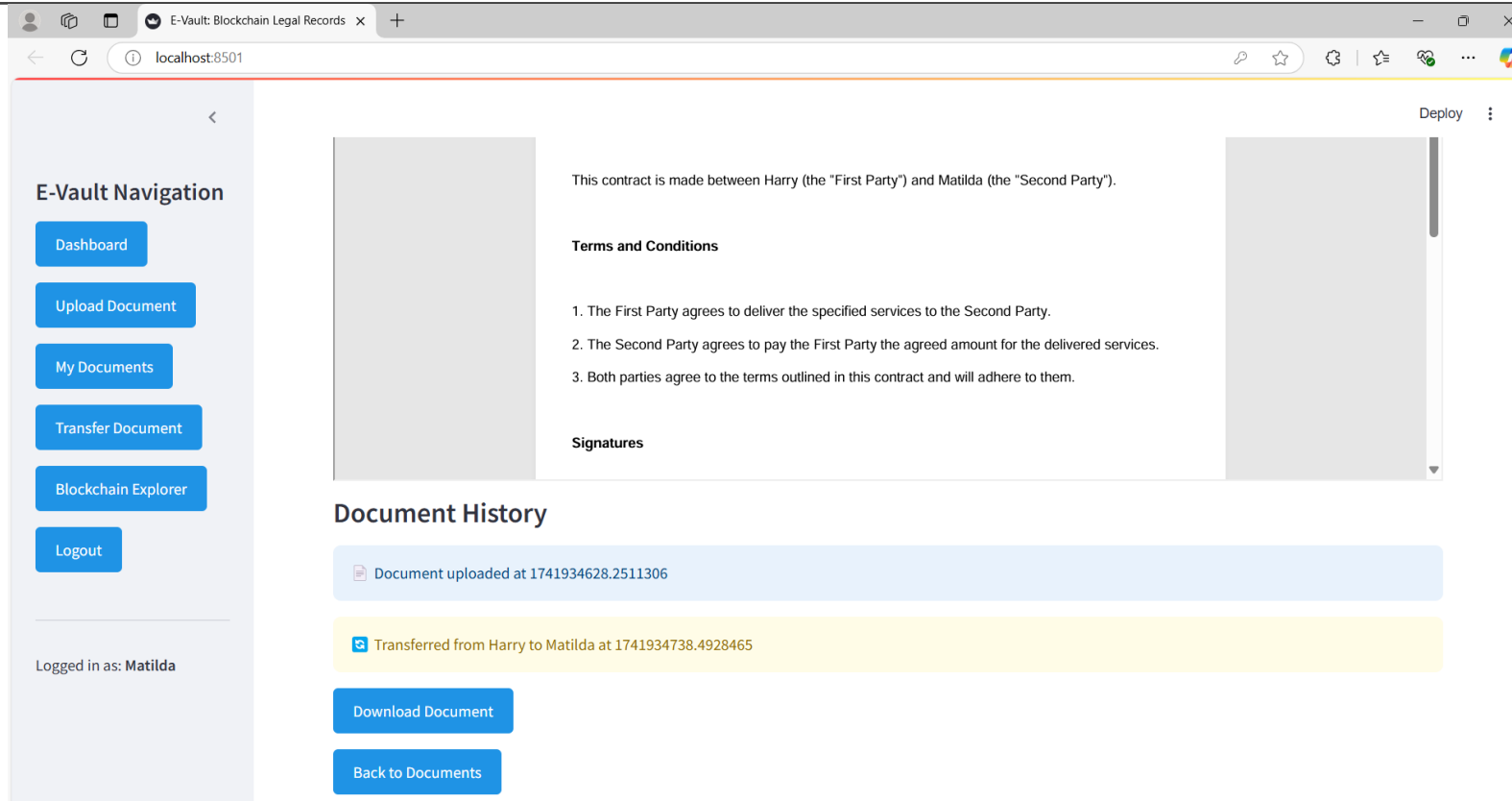


Figure 13: Document History is shown below while viewing the document: Matilda –User 2.

RESULTS:

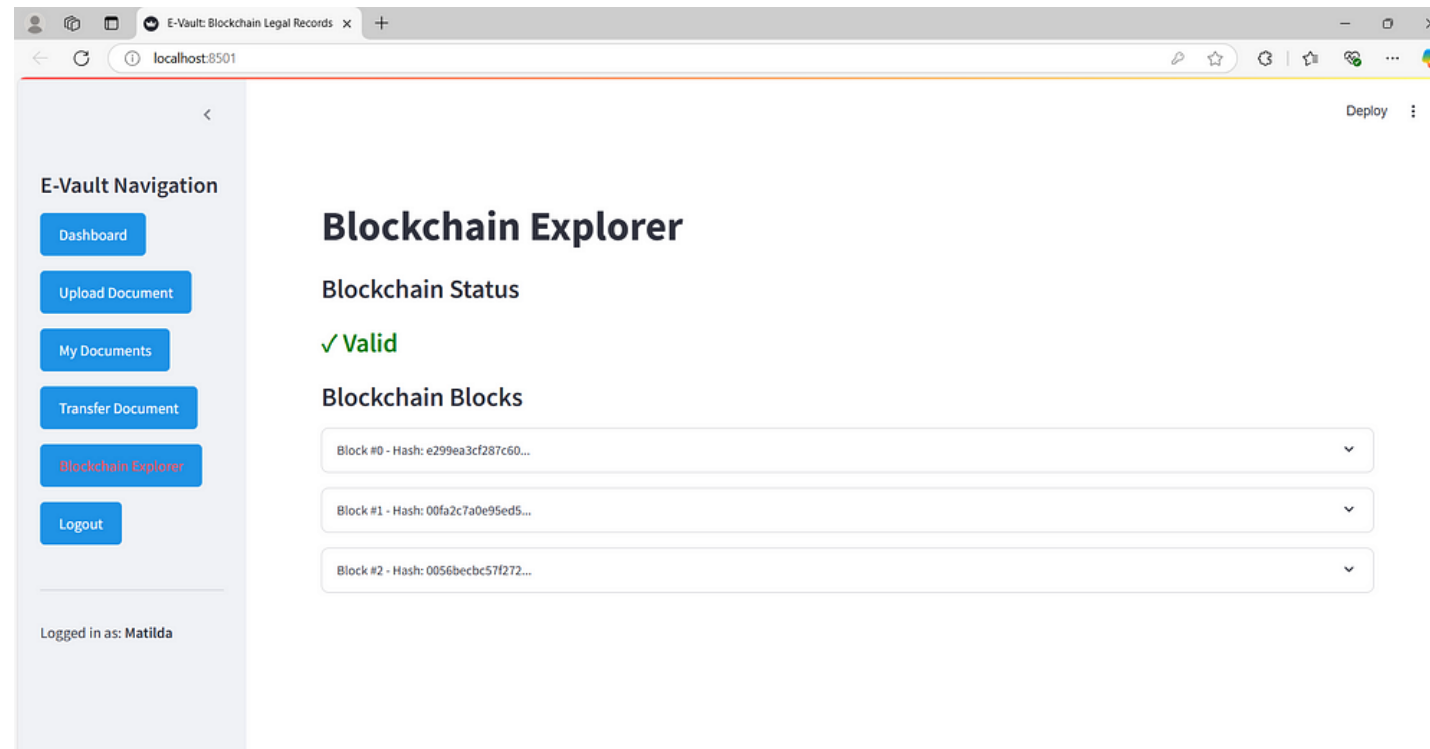


Figure 14: Blockchain explorer

RESULTS:

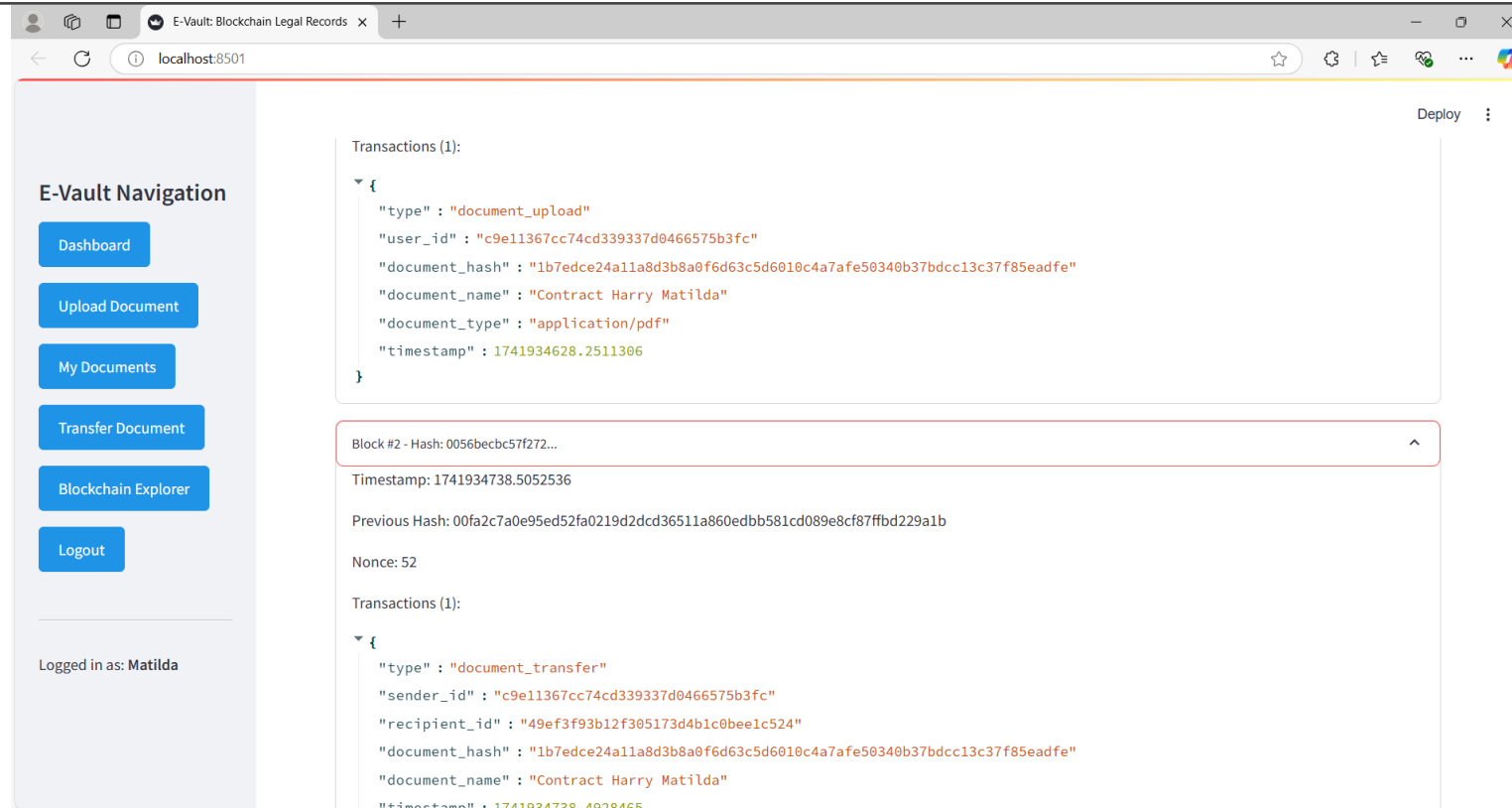


Figure 15: Blockchain explorer: Tracks all transactions

CONCLUSION

- Successfully implemented a functional blockchain-based legal records management system
- Demonstrated practical application of blockchain for document integrity
- Created secure document transfer mechanisms with ownership validation
- Developed an intuitive interface accessible to non-technical users
- Provided comprehensive document history tracking and verification
- Established a foundation for enhanced legal document management
- Balanced security requirements with usability considerations

FUTURE SCOPE

- Multi-signature approvals: Require multiple parties to authorize document transfers
- Smart contract integration: Automate legal workflows with conditional logic
- Distributed deployment: Extend to multiple nodes for true decentralization
- Mobile application: Develop companion mobile app for on-the-go access
- Advanced search capabilities: Implement content-based document search
- Regulatory compliance modules: Add jurisdiction-specific compliance validation
- Integration with legal practice management systems: Connect with existing legal workflows

References: Academic & Technical

- [1] Zheng, Z., et al. (2018). Blockchain challenges and opportunities: A survey.
- [2] Wang, S., et al. (2020). A blockchain-based framework for data sharing with fine-grained access control in decentralized storage systems.
- [3] Kumar, A., & Smith, J. (2022). Secure document transfer protocols using blockchain technology.
- [4] Chen, Y., et al. (2021). Privacy-preserving document verification using zero-knowledge proofs.
- [5] Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system.
- [6] Streamlit Documentation (2023). Building data applications with Streamlit.
- [7] PyCryptodome Documentation (2023). Python cryptography toolkit.

THANK YOU

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