

Blockfolio: Blockchain-Powered E-Portfolio for Students

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Abstract

The project introduces a platform where students can securely store and share their academic achievements, certificates and project work using blockchain technology. The platform ensures that student records are permanently stored and cannot be altered, making them trustworthy and easy to verify. Students can upload their achievements, while employers and educational institutions can check the authenticity of these records through the blockchain. By using the blockchain smart contracts, the system provides a secure and decentralized way to manage student portfolios. Additionally, files like certificates and projects are stored by utilizing ethereum allowing them to be safely accessed and verified. This platform offers students a reliable way to present their skills to potential employers and institutions, making the verification process simpler and more transparent.

The purpose of the project is to create a user-friendly interface where students can securely store and showcase their academic records, certificates, and projects. Using blockchain technology, the platform guarantees that all records are permanent and immutable. This allows employers and educational institutions to easily verify the authenticity of the students achievements. By using solidity for smart contracts, the system provides a reliable, efficient, and transparent way for students to demonstrate their qualifications and skills to potential employers and academic institutions. The overall aim is to make the process of sharing and decentralizing academic accomplishments more efficient, secure and trustworthy.

Keywords: Blockchain, Smart Contracts, Ethereum, Solidity, Academic Records, E-Portfolio, Decentralized Platform, Transparency.

Introduction

The project introduces a secure and decentralized platform for students to store and share their academic achievements, certificates, and project work using block chain technology. By leveraging the immutability and transparency of block chain, the platform ensures that student records are permanently stored, tamper-proof, and easily verifiable.

Key features include the ability for students to upload their achievements while enabling employers and educational institutions to authenticate these records directly through the block chain. Smart contracts facilitate the secure management of student portfolios, ensuring automated, trustless interactions.

Additionally, the platform integrates OrbitDB for decentralized storage of files such as certificates and projects, enhancing accessibility and security. This innovative solution simplifies the verification process, providing students with a reliable way to showcase their skills and credentials to potential employers and academic institutions.



The primary goal of the project Blockfolio is to provide students with a secure, reliable, and user-friendly platform to store, manage, and share their academic records and achievements. The project focuses on leveraging block chain technology to eliminate issues like forgery, data loss, and inefficiency in verification processes, offering a transparent and trustworthy solution for both students and verifiers.

Related Work

Platform/ Tool	Features	Limitations	Blockfolio's Improvisation
Google Forms	Collects data, allows file uploads	Centralized; files stored on Google's servers	Decentralized storage for user-controlled doc uploads
Google Docs	Document creation, editing, sharing	Centralized; data controlled by Google	Transparent & decentralized document management
LinkedIn	Professional profiles, resume and experience showcasing	Centralized; limited ownership and verf of documents	User-owned portfolio with blockchain- backed transparency
Arweave	Permanent decentralized file storage	Expensive; not built for user portfolio management	Provides inexpensive scalable storage with OrbitDB integration
Notion	Versatile note-taking, portfolio building	Centralized; lacks user ownership of data	Blockchain-based privacy and security

Proposed Work

The proposed system, Blockfolio, introduces a decentralized, blockchain-based solution aimed at overcoming the limitations of traditional, centralized document and e-portfolio management systems. At its core, Blockfolio leverages the power of blockchain technology, smart contracts, and decentralized identity standards to create a secure, transparent, and user-centric platform for managing, storing, and verifying credentials, skills, and academic achievements.

To address security concerns prevalent in current systems, Blockfolio utilizes blockchain's cryptographic mechanisms to ensure that all user data is securely encrypted and stored on a distributed ledger. The decentralized nature of the platform minimizes the risks of data breaches, hacking, and unauthorized access. Furthermore, the immutability of blockchain ensures that once credentials or achievements are recorded, they cannot be altered or deleted, providing a reliable and tamper-proof system for credential verification.

One of the major goals of Blockfolio is to empower users with full ownership and control over their data. Users can independently manage their profiles, control access permissions using smart contracts, and are not reliant on any centralized authority for updates or data retrieval. This not only enhances user autonomy but also aligns with the broader vision of self-sovereign identity.

To streamline and automate the verification process, the system incorporates smart contracts that validate credentials without the need for manual intervention. This leads to significant reductions in time, effort, and administrative costs associated with traditional verification methods. Verifiers can instantly confirm the authenticity of credentials through the blockchain, eliminating delays and increasing trust.

Blockfolio also promotes universal accessibility, allowing users to access and share their e-portfolios from anywhere in the world. Whether for academic progression, employment opportunities, or professional networking, users can



seamlessly present their verified credentials across various platforms and borders. The platform is designed with interoperability in mind, adopting standards such as Decentralized Identifiers (DIDs) and Verifiable Credentials (VCs) to ensure compatibility with diverse ecosystems, including educational institutions, employers, and global credentialing bodies.

Finally, Blockfolio enhances transparency and trust by providing all stakeholders with access to verifiable and consistent records on a decentralized ledger. This transparency fosters credibility and confidence in the system, benefiting users, verifiers, and institutions alike.

In summary, Blockfolio offers a next-generation approach to digital credential management by integrating decentralization, security, automation, and interoperability into a single robust platform. It addresses the core drawbacks of current systems while setting a foundation for scalable, digital identity and e-portfolio management.

Implementation

The Blockfolio platform is implemented as a fully decentralized, blockchain-based e-portfolio system designed to provide secure, verifiable, and user-controlled credential management. The core infrastructure is built on Ethereum, utilizing smart contracts written in Solidity to handle critical operations such as credential issuance, ownership verification, and access control. These contracts are rigorously tested using Hardhat and Truffle to ensure robustness against common vulnerabilities like attacks and integer overflows.

The frontend is developed using React.js, ensuring a maintainable and scalable codebase. The UI is enhanced with Bootstrap and Material-UI for a responsive and modern user experience. User authentication is streamlined through MetaMask, allowing secure wallet integration and transaction signing directly from the browser.

For decentralized storage, IPFS (InterPlanetary File System) is employed to store credential hashes and metadata immutably, while OrbitDB, a peer-to-peer database, enables distributed indexing and querying of user data without reliance on centralized servers. The Graph is integrated to efficiently index and retrieve blockchain data, improving performance for complex queries.

To ensure compliance with global identity standards, Blockfolio implements W3C Verifiable Credentials (VCs) and Decentralized Identifiers (DIDs), enabling cryptographically signed, tamper-proof credentials that can be verified across different platforms. Infura serves as the primary Ethereum node provider, ensuring reliable blockchain connectivity, while Alchemy is used for enhanced API support and real-time event monitoring.

The platform is deployed using Ganache for frontend hosting, with CI/CD pipelines automating testing and deployment processes. By combining these technologies, Blockfolio delivers a secure, scalable, and user-centric solution for managing academic and professional credentials in a trustless, decentralized ecosystem.

Functionality	Algorithms used	Category
User identity & access control	Metamask	Sign up and Login
Smart contract-based access control	Solidity Event & Function Management	Smart contract logic

TABLE 1. Algorithm Categorization



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Peer-to-peer database	IPFS + OrbitDB	Distributed Data Management
Secure interaction with blockchain	Web3 API Calls	Blockchain Integration
Consensus for block validation (Ethereum)	Ethereum consensus	Consensus Algorithm

FIGURE 1. System Architecture



Results

The implementation of the Blockfolio system successfully showcased its capability to deliver a secure, decentralized, and privacy-preserving framework for the management of educational records. The system effectively encrypted educational documents and stored them off-chain using IPFS, while their corresponding hash values were immutably recorded on the Ethereum blockchain, ensuring data integrity, verifiability, and resistance to tampering. This dual storage approach enhanced both the security and scalability of the application by reducing on-chain data load while maintaining a decentralized record-keeping mechanism.

Smart contracts deployed via Truffle were instrumental in governing the system's access control policies. These contracts enforced strict permissions, ensuring that only authorized stakeholders, such as students, educational institutions, and verified third parties, could access or share sensitive academic documents. Real-time interactions between the smart contract and decentralized storage were seamlessly handled through the Web3.js library, enabling smooth execution of actions such as hash verification, permission validation, and transaction confirmation.



User authentication and identity verification were facilitated through MetaMask integration, adding a robust layer of trust by linking document transactions and access permissions to unique, blockchain-based digital identities. This mechanism also enhanced transparency by allowing users to track and verify all interactions with their records directly through the blockchain network.

The decentralized web application, developed using React.js and deployed on Heroku, provided a responsive, intuitive, and interactive user interface. Integration with Infura ensured uninterrupted connectivity to the Ethereum network, enabling real-time blockchain operations without the need for maintaining a personal node infrastructure. The decentralized architecture was further supported by OrbitDB, a peer-to-peer distributed database, which improved data availability, resilience, and fault tolerance by replicating off-chain metadata across multiple nodes.

The system's performance was rigorously tested for efficiency, security, and reliability. It demonstrated the ability to maintain high levels of data confidentiality, availability, and integrity. Real-time interactions, including document uploads, hash storage, access permission validations, and document retrievals, were executed reliably without latency issues. The collaborative use of IPFS for document storage and OrbitDB for metadata management proved to be highly effective in distributing data and preventing single points of failure.

Overall, the Blockfolio system met and exceeded its primary performance objectives by delivering a decentralized, secure, and user-friendly solution for academic record management. It not only empowered users with full control over their educational credentials but also set a scalable precedent for future decentralized identity and document management systems.



Figure 2. Sign in Page





Figure 3. Records Display Page

New Record	Enter Description
Dates D	
17117270	Required for scholarship application
Augusta Aubana	
0x471E6eD3088113B1a581764024F0188c12533k	
2020-11-03 21:01:04	
Parameter Indexe	
Certificate	
	U

Figure 4. Records Upload Page



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Records			Home Logiou
List of Records			
Student ID	Record Name	Description	Created Timestamp
17117248	Certificate	jovjkzn	2020-11-03 20:29:40
		Add	
171/17270	Certificate	Required for scholarship application	2020-11-03 21:01:04
		Add	

Figure 5. List of Records

Discussion

The development and deployment of Blockfolio highlight the potential of blockchain technology in revolutionizing how sensitive educational records are managed. Traditional centralized systems are often prone to security breaches, unauthorized access, and data tampering. Blockfolio overcomes these issues by leveraging the decentralized and immutable nature of blockchain, combined with cryptographic encryption and distributed storage mechanisms like OrbitDB and IPFS.

One of the major strengths of this system lies in its hybrid approach—storing actual documents off-chain to reduce blockchain bloat, while maintaining hash values on-chain to ensure data integrity. This balances security, privacy, and efficiency. The integration of smart contracts simplifies and automates access control, ensuring that only authorized users can retrieve or share documents.

The use of Metamask enhances user authentication, while the seamless interaction with the Ethereum test network via Infura provides a scalable and low-latency environment for DApp deployment. ReactJS and Bootstrap on the frontend ensure a responsive and modern user experience.

However, some challenges were encountered during development, including handling synchronization issues with OrbitDB, optimizing gas fees on the Ethereum network, and ensuring compatibility across various browsers for Metamask functionality. Future improvements may include integrating zero-knowledge proofs for added privacy, supporting multi-chain deployment, and implementing user roles with finer-grained access control.

Overall, Blockfolio serves as a promising prototype for secure document management systems in education, with potential to be extended to healthcare, legal, and governmental sectors where data security and integrity are critical.



Conclusion

In an increasingly digital and interconnected world, the need for secure, transparent, and user-controlled credential management systems has become paramount. Traditional centralized platforms suffer from numerous drawbacks such as vulnerability to data breaches, lack of user ownership, inefficiencies in verification, and poor interoperability. The proposed Blockfolio platform addresses these critical challenges by introducing a decentralized e-portfolio system that harnesses the core strengths of blockchain technology. By building on the Ethereum blockchain and utilizing smart contracts, Blockfolio ensures that all credential-related transactions are immutable, time-stamped, and verifiable without the need for intermediaries.

The integration of Web3, Solidity, React JS, NodeJS, and OrbitDB, along with tools like Metamask, Infura, and Heroku, demonstrates a robust and modular architecture capable of supporting secure and scalable operations. Unlike traditional systems, Blockfolio gives users full ownership and control over their data, including the ability to manage access permissions and selectively share credentials with employers, institutions, or organizations. The incorporation of Decentralized Identifiers (DIDs) and Verifiable Credentials (VCs) further enhances the system's ability to interoperate with diverse platforms, aligning with global standards for digital identity and data portability.

Additionally, the platform significantly reduces administrative overhead through the use of automated verification via smart contracts, eliminating manual validation and increasing trust among all stakeholders. It enables seamless cross-border sharing of verified credentials, making it ideal for both academic and professional environments. The decentralized nature of the system also ensures that user data is not dependent on a single authority, minimizing the risk of manipulation or loss.

Overall, Blockfolio represents a pioneering step toward a future where educational and professional credentials are securely stored, transparently verified, and universally accessible. Its implementation has the potential to revolutionize how achievements are recorded and shared, shifting the control from institutions to individuals while promoting trust, privacy, and efficiency. As blockchain technology continues to mature, platforms like Blockfolio can become the foundation for next-generation e-portfolio ecosystems that align with the values of decentralization, security.

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