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SECURE ACADEMIC CREDENTIAL MANAGEMENT AND VERIFICATION USING BLOCKCHAIN

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ABSTRACT:
The concept of meritocracy is threatened by the pervasive falsification of educational credentials, which compromises the integrity of both academic institutions and employment markets. Fraud detection and prevention are challenging due to the fragmented, unsecure, and ineffective nature of traditional certificate verification techniques. With its built-in characteristics of immutability, decentralization, and tamper resistance, blockchain technology offers a viable answer to these problems. However, the scope of current blockchain-based systems is constrained; they usually only cover particular educational levels or institutions and lack full capability. In this paper, we present ElimuChain, a unified blockchain-based system for managing and verifying academic credentials across all educational levels and establishments in a nation. Employers and educational institutions may authenticate all of an individual's certifications from a single platform thanks to the system's centralized verification portal. ElimuChain is a decentralized application (DApp) built on the Binance Smart Chain (BSC) that uses IPFS for safe document storage and smart contracts for automatic certificate issuance. The implementation shows that the suggested method is affordable, scalable, and able to expedite the certification and verification procedure. When compared to current systems, performance evaluations show improved efficiency in terms of transaction throughput and latency. With an emphasis on its applicability in the Tanzanian context, this study confirms the potential of blockchain in creating a strong, transparent, and trustworthy educational credentialing environment

KEYWORDS: IPFS, DApp, ElimuChain, blockchain, educational certifications, and smart contracts.

1. INTRODUCTION

The concept of meritocracy is threatened by the pervasive falsification of educational credentials, which compromises the integrity of both academic institutions and employment markets. Fraud detection and prevention are challenging due to the fragmented, unsecure, and ineffective nature of traditional certificate verification techniques. With its built-in characteristics of immutability, decentralization, and tamper resistance, blockchain technology offers a viable answer to these problems. However, the scope of current blockchain-based systems is constrained; they usually only cover particular educational levels or institutions and lack full capability. In this paper, we present ElimuChain, a unified blockchain-based system for managing and verifying academic credentials across all educational levels and establishments in a nation. Employers and educational institutions may authenticate all of an individual's certifications from a single platform thanks to the system's centralized verification portal. ElimuChain is a decentralized application (DApp) built on the Binance Smart Chain (BSC) that uses IPFS for safe document storage and smart contracts for automatic certificate issuance. The implementation shows that the suggested method is affordable, scalable, and able to expedite the certification and verification procedure. When compared to current systems, performance evaluations show improved efficiency in terms of transaction throughput and latency. With an emphasis on its applicability in the Tanzanian context, this study confirms blockchain's potential to create a strong, transparent, and trustworthy educational credentialing environment. Recently, blockchain technology has come to light as a possible remedy for issues with counterfeiting, certification, and verification. It has revolutionized a number of industries by utilizing its special qualities, which include decentralization, distribution, immutability, tamper-proofness, anonymity, transparency, and trustlessness. Applications and adoption in various fields, including healthcare supply chain, weather, transportation, agriculture, e-government, and education, have increased dramatically since cryptocurrency's breakthrough. Additionally, it is upending established computer domains like cloud computing, IoT, and AI. Scholars and practitioners agree that, due to its unique qualities and capabilities, it can improve the issue and verification of certificates and effectively combat. It is said to provide efficiency, dependability, security, transparency, and many other advantages in the areas of certification, verification, and forgery prevention. A certificate's immutability ensures its legitimacy since once it is issued on the blockchain, it cannot be changed or falsified. Blockchain ensures that access is restricted to authorized parties, prevents manipulation, and offers verifiable verification of the certificate's provenance through digital signatures and cryptographic hashes.

2.STIMULATING

This study suggests a comprehensive blockchain-based approach to solve certification, verification, and forging difficulties in light of the aforementioned problems. It is intended to act as a one-stop shop where certifications from different educational levels across the nation can be issued, and employers and other verifiers can confirm every certificate an applicant possesses. It is specifically designed to deal with these issues in the Tanzanian setting. As a result, it is created in accordance with the Tanzanian educational qualifications framework and verification ecosystem by incorporating all relevant parties, governmental bodies, and rules related to the nation's certification procedure. To prove the feasibility of the approach, a DApp named ElimuChain is created and implemented as a proof of concept. To get over the blockchain's storage and processing constraints, it makes use of smart contracts for functional logic and the IPFS as an off-chain solution for big data. To test and assess its viability, it was implemented on the BSC blockchain.

3. OBJECTIVE

This study suggests a comprehensive blockchain-based approach to solve certification, verification, and forging difficulties in light of the aforementioned problems. It is intended to act as a one-stop shop where certifications from different educational levels across the nation can be issued, and employers and other verifiers can confirm every certificate an applicant possesses. It is specifically designed to deal with these issues in the Tanzanian setting. As a result, it is created in accordance with the Tanzanian educational qualifications framework and verification ecosystem by incorporating all relevant parties, governmental bodies, and rules related to the nation's certification procedure. To prove the feasibility of the approach, a DApp named ElimuChain is created and implemented as a proof of concept.

3.1 WHAT THE PROJECT IS ABOUT

The goal of this project is to create a Blockchain-Powered Platform for Secure Management and Verification of Educational Credentials that makes certificate verification easier and helps stop fraudulent certificates. Digital certificates can be issued by educational institutions, and each one is protected by SHA-256 hashing and kept on the blockchain, rendering it unchangeable and impenetrable. Smart contracts are used by the system to automate access control, verification, and certificate issuing. Certificates may be safely stored and shared by students, and employers can quickly confirm their legitimacy without having to get in touch with schools directly. Additionally, IPFS (Inter Planetary File System) is integrated into the platform for decentralized certificate storage. The system may be easily accessed by administrators, institutes, students, and employers through a JSP-based web dashboard. Transparency, security, and an ongoing audit trail of every certificate transaction are guaranteed by the blockchain. The technology decreases fraud, gets rid of manual verification delays, and boosts confidence in academic qualifications. All things considered, the project offers a decentralized, scalable, and safe way to manage and validate academic credentials.

4. EXISTING SYSTEM:

The current educational credential management and verification systems are mostly fragmented, institution-specific, and centralized. Certificates are normally issued and stored individually by each educational institution, frequently in physical form or in isolated digital systems with little to no interchange. Verification procedures, which mostly rely on institutional communication, physical document inspection, or third-party verification services, are laborious, error-prone, and manual. Due to the absence of a cohesive and secure framework, these techniques are susceptible to data manipulation, delays, and falsification. Additionally, there isn't a single platform that allows verifiers—like employers or educational institutions—to quickly access and confirm a candidate's whole academic history across all institutions and educational levels. The trust, openness, and scalability of educational credential verification are severely hampered by this disjointed and ineffective paradigm. This procedure is laborious, uneven amongst institutions, and extremely prone to mistakes and forgeries, particularly when credentials are shown in easily manipulable digital or printed formats. Additionally, the approach is unstable and inefficient for large-scale or national-level verification demands because there is no shared ledger or centralized system that enables verifiers to verify credentials across several organizations.

4.1 Existing System Disadvantages:

- Manual verification is ineffective and time-consuming.
- It is simple to falsify or modify certificates without anyone noticing.

4.2 THE SUGGESTED SYSTEM

- The suggested system combines a number of fundamental technologies and algorithms to provide safe and effective certificate management and verification.
- Transparency and tamper-proof data storage are ensured by the blockchain technology, which is implemented on the Binance Smart Chain (BSC) and functions as an immutable, decentralized ledger that records all certificate transactions. Solidity-written smart contracts automate crucial procedures including verification, role-based access control, and certificate issuance.
- These agreements guarantee that credentials can only be issued by approved educational institutions and that verifiers can verify them independently of middlemen.
- The system employs the SHA-256 hashing method, which creates a distinct, fixed-size hash

for every certificate file, to ensure data integrity and prevent document forgeries.

- During the verification process, this hash is kept on the blockchain and compared to make sure the certificate hasn't been tampered with. Furthermore, the Interplanetary File System (IPFS), a decentralized storage network that creates a content-addressed hash (CID) for retrieval, is where the original certificate files are kept. When combined, these algorithms provide a safe, scalable, and affordable defence against academic credential fraud.

4.2.1 Proposed System Advantage

- Uses blockchain technology to provide unchangeable and tamper-proof certificate records.
- Removes single points of failure, strengthening security.

5. METHODOLOGIES

1. Design of User Interfaces

The user must enter their username and password in order to connect to the server. The user can log in to the server directly if they have previously left; otherwise, they must register their information, including their username, password, email address, city, and country. To manage upload and download rates, the database will create an account for every user. The user ID will be used as the name. To access a certain page, you typically need to log in. The query will be searched and displayed. **2.Institue**

Educational institutions can register and receive administrative permission through the Institute module. Through the website, students can receive diplomas from accredited institutions. Information about certificates is safely kept and connected to blockchain records. This module guarantees that academic credentials can only be produced by reputable institutions. It is essential to preserving the legitimacy of certificates.

3. Student

Students can register and enroll in an authorized institution through the Student module. Students can examine and track the status of their awarded certificates by logging in. For the purpose of verification, they can safely give employers access to the Certificate ID (CID). Students will have simple access to their validated academic qualifications thanks to this module. Additionally, it makes certificate ownership and sharing transparent.

4. Admin

All system users must be managed and approved by the Admin module. Requests for registration from employers, institutions, and students are validated and approved by the administrator. It guarantees that the platform is only accessible by authorized users. The module regulates access rights and protects system integrity. Additionally, the administrator keeps an eye on user management and system activity.

5. Employee

Employers can check student certificates through the Employee module. Students provide their Certificate ID (CID) to employers, who utilize it for verification. The system compares the certificate details with blockchain data and stored records. This makes it easier for companies to distinguish between authentic and fraudulent credentials. It does away with the requirement for manual institutional verification.

6. TECHNIQUE ALGORITHM USED

6.1 Proposed Algorithm

Blockchain, Smart Contract, SHA-256

The suggested solution combines a number of fundamental technologies and algorithms to provide effective and safe certificate management and verification. Transparency and tamper-proof data storage are ensured by the blockchain technology, which is implemented on the Binance Smart Chain (BSC) and acts as a decentralized, immutable ledger that documents all certificate transactions. Solidity-written smart contracts automate crucial procedures including verification, role-based access control, and certificate issuance. These agreements guarantee that credentials can only be issued by approved educational institutions and that verifiers can verify them independently of middlemen. The system employs the SHA-256 hashing method, which creates a distinct, fixed-size hash for every certificate file, to ensure data integrity and prevent document forgeries. During the verification process, this hash is kept on the blockchain and compared to make sure the certificate hasn't been tampered with. Furthermore, the Interplanetary File System (IPFS), a decentralized storage network that creates a content-addressed hash (CID) for retrieval, is where the original certificate files are kept. When combined, these algorithms provide a safe, scalable, and affordable defense against academic credential fraud.

6.2 EXISTING SYSTEM

Traditional System

The verification of educational certificates using the Traditional System method is a manual, institution-dependent procedure devoid of automation, security, and transparency. This method requires the verifier to manually get in touch with the issuing institution to verify the legitimacy of the academic credential that a candidate submits for verification—usually to an employer or another institution. This frequently entails written contact, phone calls, or emails. The institution then verifies the certificate details by searching its internal records, which may be kept in segregated databases or on paper. The certificate is marked as possibly fraudulent if it is not discovered, in which case the institution verifies its authenticity. This procedure is laborious, uneven amongst institutions, and extremely prone to mistakes and forgeries, particularly when credentials are shown in easily manipulable digital or printed formats.

Additionally, the approach is unstable and inefficient for large-scale or national-level verification demands because there is no shared ledger or centralized system that enables verifiers to verify credentials across several organizations.

7. SYSTEM ARCHITECTURE

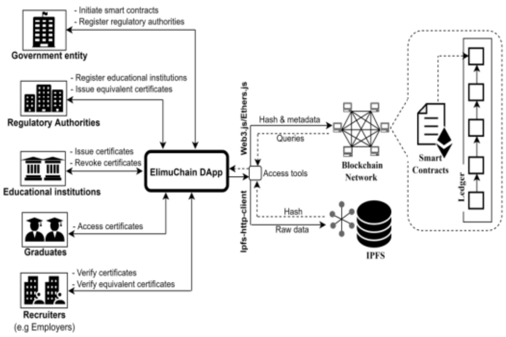
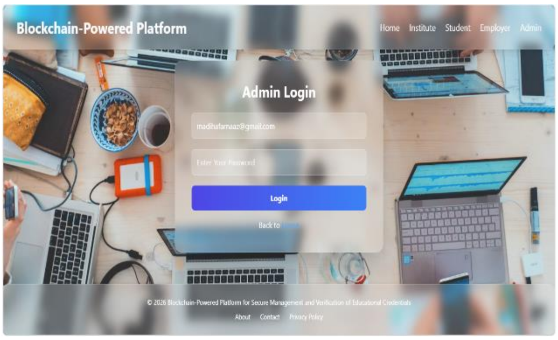
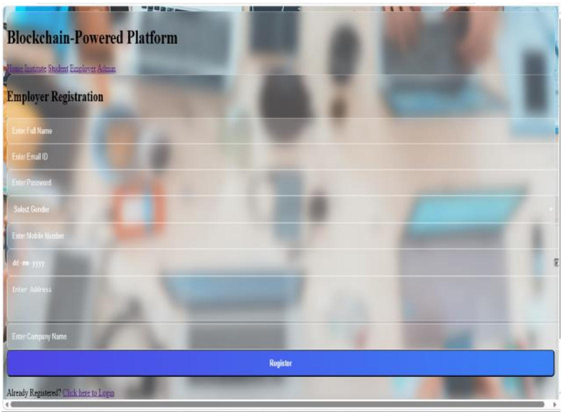
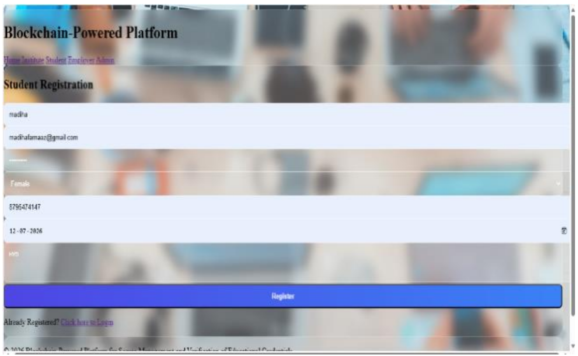


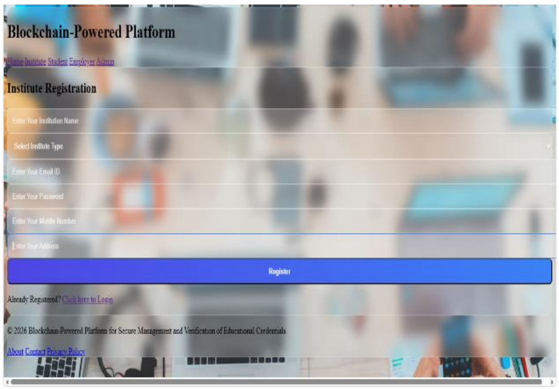
FIG:7 System Architecture

8. RESULTS









9. CONCLUSION

To sum up, the Blockchain-Powered Platform for Secure Management and Verification of Educational Credentials effectively tackles the issues of manual verification, certificate fraud, and the opaqueness of conventional systems. The project guarantees academic records' immutability, integrity, and trust by utilizing blockchain technology. By automating permission processes between organizations, students, staff, and administrators, smart contracts minimize human mistake and intervention. While the Institution module safely distributes credentials, the admin module effectively handles and verifies registration requests. The Student and Employee modules allow users to access and share verified credentials with confidence. By creating digital fingerprints for stored records that are impervious to tampering, SHA-256 hashing guarantees data integrity. Scalability and maintainability are enhanced by the system's modular architecture. All operations are strengthened by role-based access control. For employers and other stakeholders, the platform offers a decentralized, transparent verification process. All things considered, the project shows how blockchain technology may transform credential administration by providing a safe, dependable, and effective solution appropriate for actual educational ecosystems.

FUTURE ENHANCEMENT

The future enhancements of the Blockchain-Enhancing scalability, automation, and practical adoption are the main goals of the Powered Platform for Secure Management and Verification of

Educational Credentials. The incorporation of sophisticated smart contracts to completely automate certificate issue, revocation, and expiration without human intervention is one significant improvement. Institutions can publish credentials across several blockchain networks by expanding the platform to accommodate multi-blockchain interoperability. Student identification verification will be strengthened even more by implementing digital identity management with decentralized identifiers (DIDs). Employers can use mobile devices to immediately validate certificates by enhancing the system with QR-code-based certificate verification. Large certificate files can be safely stored while preserving blockchain hash references by utilizing IPFS or distributed storage. Suspicious verification patterns can be identified by adding AI-based fraud detection systems. Multilingual interfaces and support for foreign organizations can improve usability worldwide. Dashboards for role-based analytics can offer information about certificate issuance and verification processes. Authenticity and trust will increase with integration with government or academic portals. All things considered, these improvements will make the platform more intelligent, scalable, and appropriate for extensive educational ecosystems.

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