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SECURE BLOCKCHAIN FOR ADMISSION PROCESSING IN EDUCATIONAL INSTITUTIONS

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ABSTRACT

Blockchain technology with its secure mechanism of maintaining data and transactions in shared, immutable, distributed ledgers has become very relevant today and is increasingly used for financial applications. This paper proposes the use of consortium blockchain and smart contracts for secure, transparent and automated processing of student applications received by educational institutions. The students applying for admissions in educational institutions need assurance of a safe, secure and transparent platform that does not compromise their privacy. On the other hand, educational institutions too need assurance about the authenticity of the documents and the applicant. The use of consortium blockchain and smart contracts incorporating business logic for validating, verifying and filtering of valid applications provides a safe and secure platform for processing student applications. This paper looks at blockchain application beyond finance and explains how the student registration and admission process can be made safe and secure for all stakeholders. It promotes a seamless mechanism with reduced turnaround time and increased security and transparency.

Keywords: Block chain Technology, Consortium Block chain, Smart Contracts, Student Applications, Educational Institutions, Secure Platforms, Transparency, (DLT)

I. INTRODUCTION

Blockchain Technology whose emergence is generally associated with bitcoins is now employed for secure, immutable applications in the sectors like finance, healthcare, governance and business operations. This technology has attracted attention as the basis of cryptocurrencies such as Bitcoin, but its capabilities extend far beyond that, enabling existing technology applications to be vastly improved and new applications that was not considered practical earlier to be now deployed. This paper proposes a secure, smart contract-based autonomous system of student admission processing that leverages the inherent security of blockchain technology to provide a secure and transparent system of processing student applications.

Blockchain has been already applied in a few fields in the education sector such as:

a) A record keeping system for certificates and degrees.

b) A system to enhance transactions and payments with security between two parties.

c) A system promoting collaboration between universities.

We propose a blockchain based system for registering, validating and selecting the student applications for various university courses. Student applicants belong to different countries which may have different educations systems. Besides, different countries may have their own rules pertaining to student visa and the required procedure and documents. Students applying for admissions are required to submit/upload various forms and documents. While students need assurance of a safe and secure platform that does not compromise the privacy of their data, the educational institutions too need assurance about the authenticity of the documents and applicant. This paper examines the possibility of using blockchain for a secure, automated smart contract which streamlines the admission process and assures both student and university of an unbiased, secure and authenticated processThe paper is structured as follows. Literature review and the background of blockchain technologies is discussed in section II. Section III discusses the proposed methodology. Section IV and V discuss the advantage and limitations of the proposed system of admission using blockchain respectively. Section VI examines the future scope of blockchain in the education sector and section VII concludes the paper.

II. RELATED WORK

The origin of blockchain dates back to 1991, when researchers Stuart Haber and W. Scott Stornetta outlined a system to document timestamps that could not be altered. However, it is most widely known as the underpinning of Bitcoin, introduced to the tech world when Bitcoin's pseudonymous creator, Satoshi Nakamoto, referred to it as "a new electronic cash system that's fully peer-to-peer, with no trusted third party." Soon after that, Blockchain became the next possible bedrock of record-keeping worldwide and the underlying distributed ledger technology (DLT) that powers many of the most popular digital currencies.

A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone

This paper enlightens the stipulation of blockchain beyond the bitcoin and identifies the key challenges in the implementation of blockchain on a small scale or newly implemented projects based on the literature review, furthermore it also introduces Block maturity level (BML) as a Consensus protocol, which eliminates the 51% attack, the hardfork problem and small-scale problem by introducing sub-blocks as a defense mechanism against attackers. This technique can be used in the

implementation of blockchain where the hash power and difficulty is lower and easy to match-up. This proposed consensus protocol would immensely secure the implementation of the blockchain on different projects.

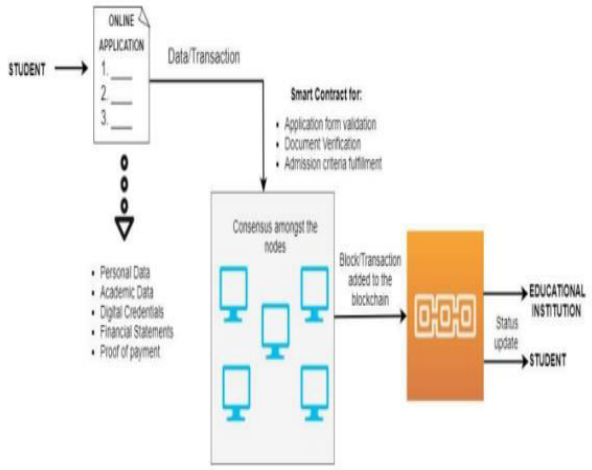

Fig:1. System Architecture

III. IMPLEMENTATION

1. **Blockchain Network Setup**

Platforms like Hyperledger Fabric or Quorum are used to create a consortium blockchain network.
Nodes representing institutions, verifying authorities, and students are configured, ensuring secure and efficient communication.

2. Smart Contract Development

Smart contracts are developed using Solidity (for Ethereum-based platforms) or Chaincode (for Hyperledger) to automate key functions such as verification and eligibility checks.
These contracts encode institutional admission policies and ensure adherence to predefined rules.

3. Data Storage and Privacy

Document hashes are stored on-chain for immutability, while the actual files are saved in secure off-chain storage systems such as IPFS.
- Encryption techniques safeguard sensitive data, ensuring compliance with privacy regulations like GDPR.

4. User Interface

A user-friendly web or mobile application is designed for stakeholders to interact with the system.
Role-based access controls restrict data visibility to authorized users only, enhancing security.

5. Testing and Deployment

The system undergoes rigorous testing for functionality, scalability, and security on a testnet before transitioning to production.
Feedback from stakeholders is incorporated to refine the platform further.

IV. ALGORITHM

Blockchain technology, renowned for its secure mechanism of maintaining data and transactions in shared, immutable, distributed ledgers, has transcended its financial origins to offer innovative solutions across various sectors. This paper explores how consortium blockchain and smart contracts can revolutionize the processing of student applications for educational institutions, providing a secure, transparent, and efficient platform for all stakeholders. Students applying for admissions require assurance of a safe, secure, and transparent platform that protects their privacy and guarantees the authenticity of the process. On the other hand, educational institutions demand a reliable mechanism to verify documents and validate the credentials of applicants. By leveraging blockchain technology, this system eliminates inefficiencies, reduces turnaround times, and ensures trustworthiness in the admission process.

The system proposed utilizes consortium blockchain and smart contracts to automate and secure the student admission process. Below is the algorithm:

Initialization Phase

1. A consortium blockchain network is established, incorporating educational institutions, students, and verifying authorities as nodes.
2. Smart contracts are designed to handle admission processes, including document verification, eligibility checks, and notifications.

Student Registration

1. Students register by providing personal details and uploading documents such as certificates and transcripts.
2. The documents are hashed and the hashes are stored on the blockchain, ensuring integrity and traceability. The actual files are stored securely off-chain.

Document Verification

1. Smart contracts initiate workflows to verify documents by sending them to designated authorities (e.g., universities or government bodies).
2. Verification results are recorded on-chain for accessibility and transparency.

Application Filtering

1. Smart contracts evaluate applications against predefined eligibility criteria such as academic scores and required certifications.
2. Invalid or incomplete applications are automatically flagged, reducing manual effort.

Transparency and Notifications

1. The blockchain records all steps, including submission, verification, and filtering, creating an auditable trail.
2. Real-time notifications inform students and institutions about the status of applications.

Admission Decision and Enrollment

1. Institutions review verified and filtered applications to make admission decisions, which are recorded on the blockchain.
2. Accepted students confirm their enrollment, completing the process in a secure and immutable manner.

Document Hashing and Integrity Verification

In the blockchain system, student documents are hashed using cryptographic hash functions like SHA-256. The hash ensures data integrity, as even a minor change in the document alters the hash completely.

A)Hash Calculation Formula:

Let DDD be the document (e.g., transcript or certificate). The hash H is calculated as:

$$H = \text{HashFunction}(D)$$

For instance, using SHA-256:

$$H = \text{SHA-256}(D)$$

B)Verification Process:

During verification, the hash H′ of the uploaded document is recalculated and compared with the original stored hash H:

$$\text{If } H' = H, \text{ the document is valid.}$$

Eligibility Filtering Based on Thresholds

Smart contracts evaluate applications based on predefined eligibility criteria, such as a minimum score..

A)Eligibility Check Formula:

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$$\text{Eligible} = \begin{cases} \text{True}, & \text{if } S_i \geq S_{\min} \\ \text{False}, & \text{if } S_i < S_{\min} \end{cases}$$

Efficiency Analysis

A)Transaction Time Calculation:

Each transaction (e.g., document submission, verification) involves computational operations. Let:

Time taken to compute a hash.

Time taken to verify a document.

Time to store the transaction on the blockchain.

The total time for a single transaction TtotalT_\text{total}Ttotal is:

$$T_{\text{total}} = t_{\text{hash}} + t_{\text{verification}} + t_{\text{tx}}$$

Consensus Mechanism

The consortium blockchain uses a consensus mechanism like **PBFT (Practical Byzantine Fault Tolerance)**. Each transaction requires agreement among nnn nodes, where at least must agree for a valid transaction.

A)Validation Formula:

Let nnn be the total nodes and fff the maximum faulty nodes.

$$\text{Required Validations} = \lceil \frac{2n}{3} \rceil + 1$$

Cryptographic Key Management

Each student and institution uses asymmetric encryption for secure communication. Let:

Encryption and Decryption Formula:

For a document D, the encrypted data E is:

$$E = \text{Encrypt}(D, P_u)$$

The decrypted data D' is:

$$D' = \text{Decrypt}(E, P_r)$$

V. RESULTS

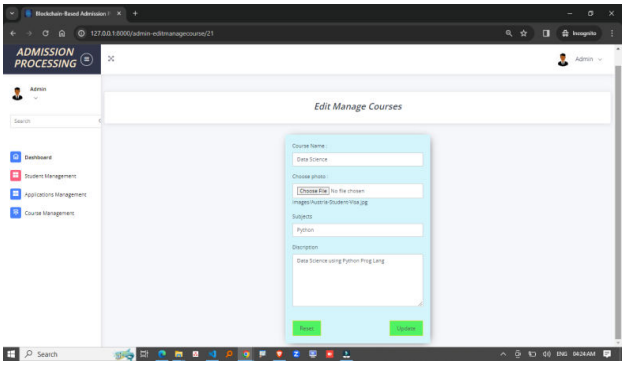

Fig:1. Admission processing

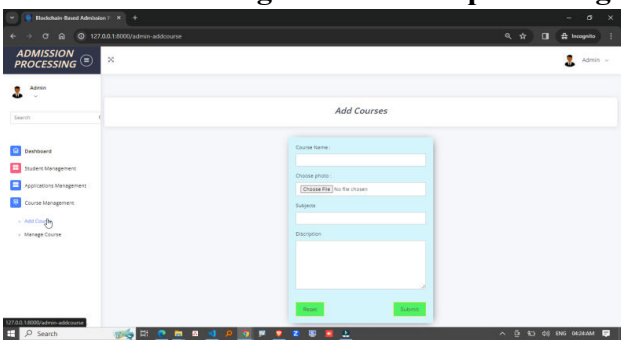

Fig:2. Add course

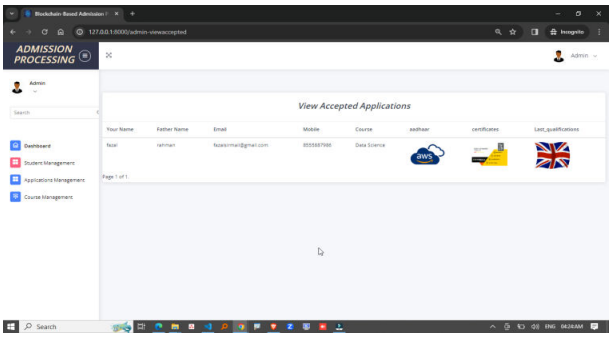

Fig:3 View Accepted Application

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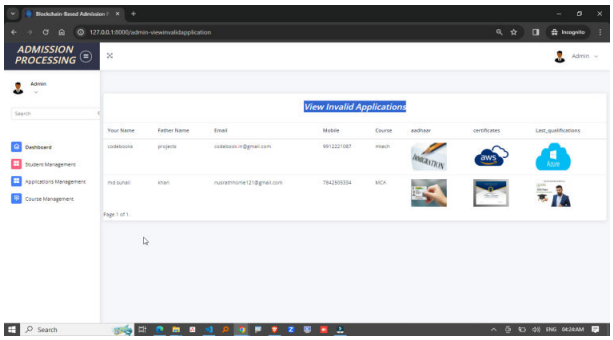

Fig:4 View Invalid Application

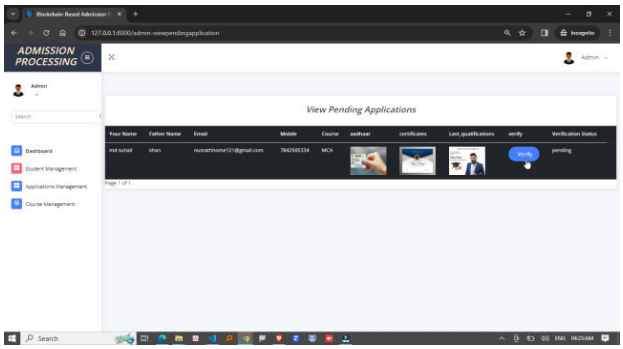

Fig:5 View Pending Applications

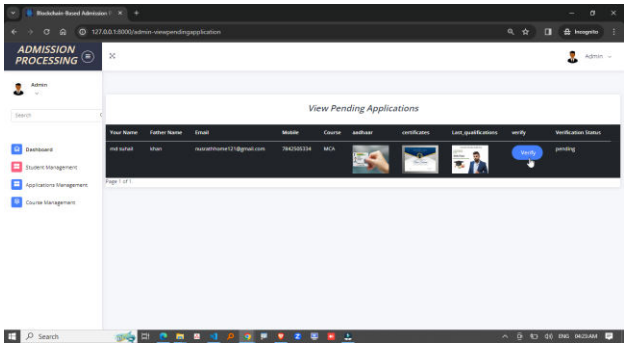

Fig:6 View Students

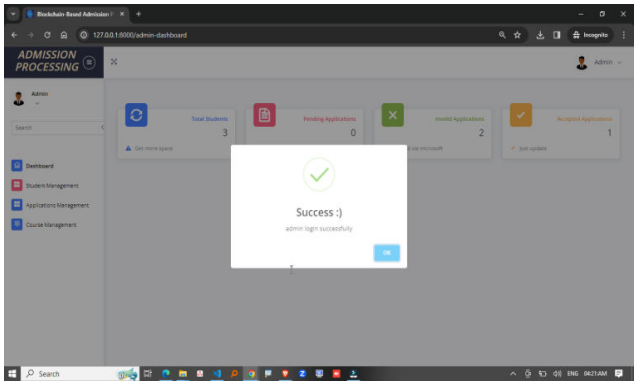

Fig:7 Admin Login Successfully

VI. CONCLUSION

The integration of blockchain technology, specifically consortium blockchain and smart contracts, into the student admission process addresses long-standing challenges in security, transparency, efficiency, and trust. This innovative approach transforms the traditional admission process into a streamlined, automated, and secure framework that benefits all stakeholders, including students, educational institutions, and verifying authorities. Below is an expanded exploration of the conclusions, highlighting the system's capabilities and potential impact.The use of blockchain ensures that the integrity of student data and application documents is maintained. By storing document hashes on the blockchain, any tampering or alteration of documents becomes detectable, preserving trust in the authenticity of the information. Furthermore, role-based access controls implemented through smart contracts restrict data visibility, ensuring that sensitive information is accessible only to authorized users. The immutable nature of the blockchain ledger eliminates concerns about data manipulation, making it a reliable platform for secure transactions.A key advantage of blockchain technology is its ability to create a transparent and auditable trail of all transactions. Every step of the student application process, from document submission to verification and decision-making, is recorded on the blockchain.

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