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# Student Certificates Authentication and Verification System using Blockchain

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**Abstract -** Education is essential for everyone, and throughout their academic journey, students earn various certificates. These certificates are crucial when applying for jobs in both public and private sectors, where they must be manually verified. Unfortunately, some students may present fake certificates, making it difficult to detect fraudulent documents. This issue of counterfeit academic certificates has plagued the academic community for years. To enhance the security and integrity of this data, digitization is necessary, adhering to the principles of Confidentiality, Integrity, and Availability. Blockchain technology can provide a solution.

Blockchain technology offers inherent security features that make it ideal for generating digital certificates that are tamper-proof and easy to verify. Each certificate would be associated with a unique hash key (QR code), allowing any organization to authenticate the certificate's legitimacy through a dedicated portal. This system not only reduces the risk of students losing or damaging their certificates but also simplifies the validation process. By leveraging blockchain, we can create a more secure, reliable, and accessible method for managing academic credentials.

**Keywords -** Unique Hash Key, QR Code, Education, Certificates, Blockchain Technology, Security

## I. INTRODUCTION

In traditional document verification, institutions face challenges such as delays, high costs, and risks of forgery. Blockchain technology provides a decentralized and tamper-proof solution. By storing cryptographic hashes of certificates on the blockchain and the actual files in a distributed file system (IPFS), the system reduces inefficiencies and improves trust in verification processes.

## II. OBJECTIVES

- Develop a secure, automated document verification system.
- Eliminate reliance on third-party verification processes.
- Reduce the time and costs associated with certificate validation.

- **Enhance Data Integrity:** Ensure the immutability of academic records by leveraging blockchain's cryptographic security.
- **Streamline Verification Processes:** Reduce the time required to validate certificates through automated and decentralized mechanisms.
- **Promote Global Accessibility:** Enable stakeholders worldwide to verify documents without relying on centralized institutions.
- **Support Scalability**: Design a system capable of handling large-scale adoption across multiple universities and organizations.
- **Ensure User Privacy:** Protect sensitive information during the verification process by using cryptographic techniques and decentralized storage.
- **Facilitate Interoperability**: Allow seamless integration with other blockchain-based platforms for broader application across industries.
- **Reduce Environmental Impact**: Optimize blockchain operations to lower energy consumption by utilizing efficient consensus mechanisms such as Proof of Stake (PoS).

## III. PROBLEM STATEMENT

The existing system for validating academic certificates relies heavily on manual processes and central authorities. These approaches are slow and vulnerable to human errors and collusion. The inability to verify the authenticity of certificates in real-time creates risks for employers and institutions. To address these challenges, blockchain technology offers a solution by enabling transparent, immutable, and decentralized certificate verification.

## IV. PROPOSED SYSTEM

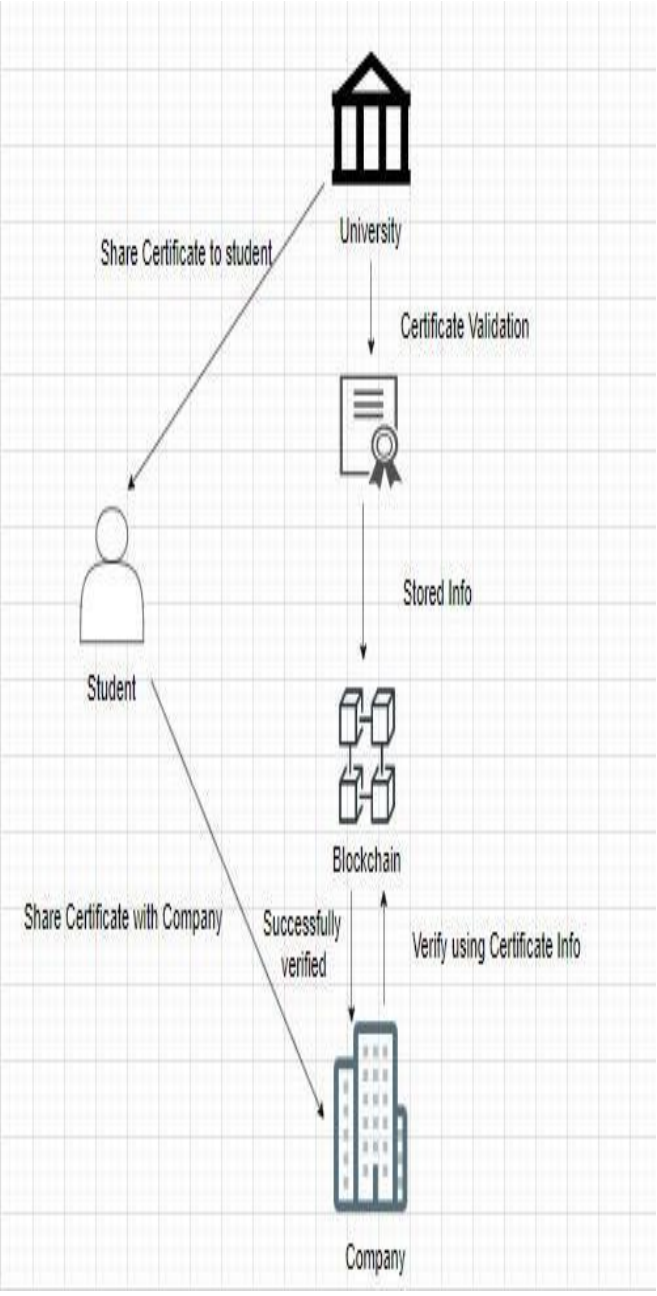
The proposed system integrates blockchain, IPFS, and QR code technology to create a robust document verification system:

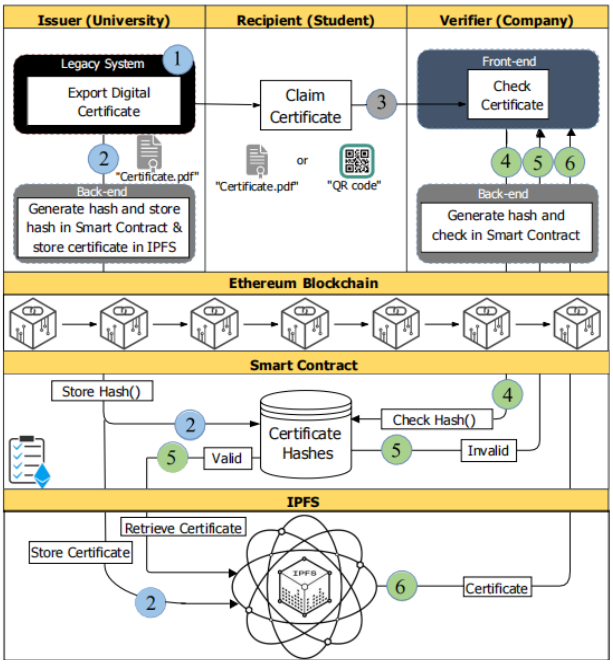
1. **Certificate Hashing**: Each certificate is hashed to create a unique digital fingerprint.
2. **Blockchain Storage**: The hash is stored on the Ethereum blockchain using a smart contract.
3. **IPFS Integration**: The certificate file itself is stored in IPFS, with a link stored in the blockchain.
4. **Verification via QR Code**: A QR code is generated for each certificate, allowing real-time validation.

**System Workflow:**

1. Universities issue certificates and upload them to the system.
2. The system hashes the document and stores it on the blockchain.
3. Verifiers scan the QR code or upload the file to validate its authenticity.

## V. ARCHITECTURE





## VI. SOFTWARE REQUIREMENTS

- **Operating System**: Windows, Linux, macOS
- **Programming Language**: Solidity, JavaScript
- **Tools**: Remix IDE, MetaMask, IPFS, Web3.js
- **Platform**: Ethereum, Conflux espace(testnet)

## VII. TECHNOLOGY DESCRIPTION

**Blockchain Technology:**
A decentralized ledger that records transactions securely. Key features include immutability, transparency, and decentralization.
**IPFS:** A peer-to-peer distributed system for storing and accessing files. It ensures efficient and secure retrieval of certificate files.
**Smart Contracts:**
Self-executing code deployed on the Ethereum blockchain to manage the verification process.
**Consensus Mechanism:**
The system leverages Proof of Stake (PoS) to ensure scalability and reduce transaction costs.

## VIII. PACKAGES USED

Here are the **packages used** in the implementation of the blockchain-based document verification system:

1. **Solidity**: A programming language for writing smart contracts on the Ethereum blockchain.

2. **Web3.js**: A JavaScript library to interact with the Ethereum blockchain. Used for sending transactions, fetching data, and interacting with smart contracts.

3. **IPFS API**: Allows interaction with the InterPlanetary File System (IPFS) for storing and retrieving documents.

4. **MetaMask**: A cryptocurrency wallet and gateway to blockchain applications. Used to connect the system to the Ethereum network.

5. **Remix IDE**: A browser-based IDE for writing, testing, and deploying Solidity smart contracts.

6. **Conflux Espace(Testnet)**: A personal Ethereum blockchain for testing smart contracts locally..

7. **Node.js**: A JavaScript runtime used for building the backend and interacting with blockchain networks.

8. **Bootstrap**: A front-end framework for creating responsive web interfaces.

9. **Express.js**: A Node.js framework used to build the backend server.

10. **JSON-RPC**: A remote procedure call (RPC) protocol for communication with blockchain nodes.

## IX. ALGORITHM

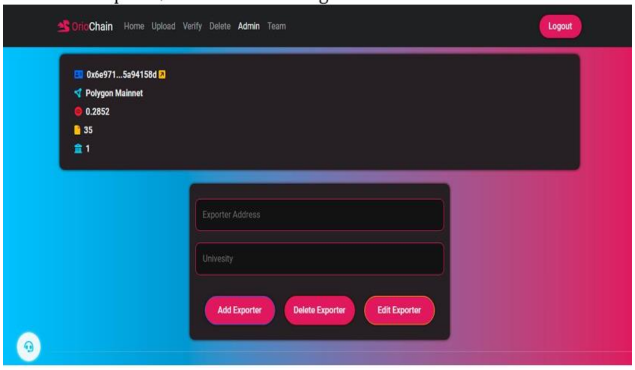
The core functions of the smart contract include:

i. **Add Exporter:** Allows universities to register authorized personnel for certificate issuance.
ii. **Upload Certificate:** Hashes and uploads the document to the blockchain and IPFS.
iii. **Verify Certificate**: Matches the uploaded document's hash with the blockchain record.
iv. **Delete Certificate:** Removes invalid or incorrect records when necessary.

## X. OUTPUTS

### 1. Certificate Issuance by Institutions:

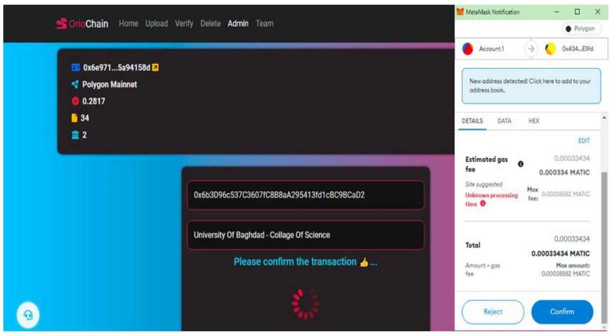
Institutions responsible for issuing certificates digitally encode the credentials along with relevant information about the certificate holder. Each certificate is assigned a unique digital
identifier.



0x6e971...5a94158d
Polygon Mainnet
0.2852
35
1

### 2. Blockchain Integration by Institute:

The institute integrates blockchain technology into its certificate issuance process. Certificate data, including the unique identifier and credential details, is securely recorded on a blockchain network.



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Polygon Mainnet
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2

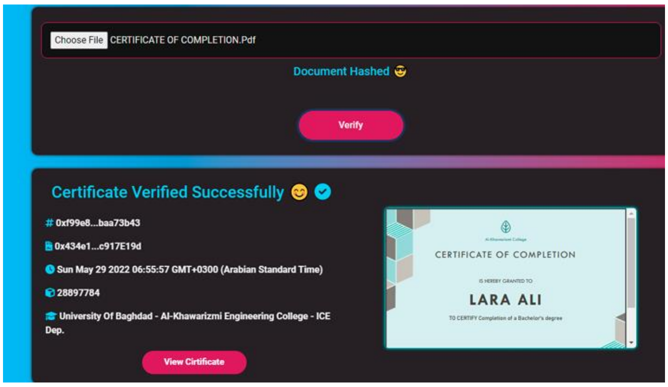
0x6b3D96c537C3607fC8B8aA295413fd1cBC9BCaD2
University Of Baghdad - Collage Of Science
Please confirm the transaction 👍 ...

New address detected! Click here to add to your address book.

Estimated gas fee 0.00033434 0.000334 MATIC
Site suggested
Unknown processing time
Max fee: 0.00038552 MATIC
Total 0.00033434 0.00033434 MATIC
Amount + gas fee
Max amount: 0.00038552 MATIC

### 3. Institute and Company Registration:

Companies and institutes register on the blockchain platform to access certificate verification services. Their identities are verified, and they are granted access to the blockchain platform's validation functionalities.



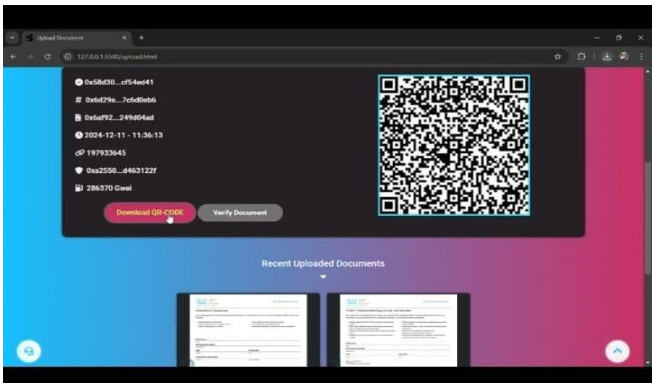
CERTIFICATE OF COMPLETION.Pdf
Document Hashed 😎

Certificate Verified Successfully 😊 ✓
0xf99e8...baa73b43
0x434e1...c917E19d
Sun May 29 2022 06:55:57 GMT+0300 (Arabian Standard Time)
28897784
University Of Baghdad - Al-Khawarizmi Engineering College - ICE Dep.

CERTIFICATE OF COMPLETION
IS HEREBY GRANTED TO
LARA ALI
TO CERTIFY Completion of a Bachelor's degree

### 4. Certificate Verification by Employers:

When an employer needs to verify a candidate's credentials, they access the blockchain platform. They retrieve the certificate data from the blockchain by searching for the unique identifier associated with the candidate's credential.



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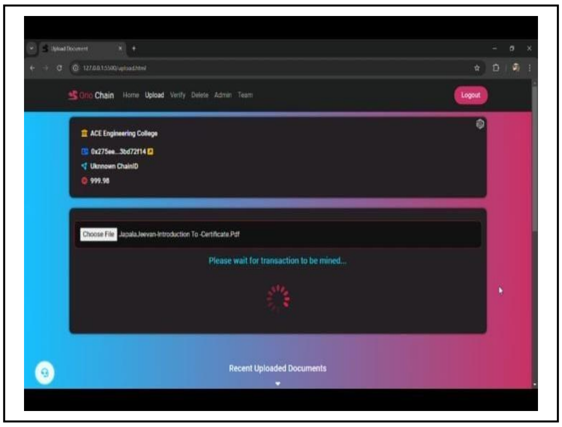
286370 Gwei

5. **The blockchain-based certificate validation system:** Is designed to be scalable to accommodate a large volume of certificates. Interoperability with existing systems and standards ensures seamless integration with the employer's verification processes.



ACE Engineering College
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JapalaJeevan-Introduction To -Certificate.Pdf

Please wait for transaction to be mined...

## XI. TESTING

Various testing methodologies were employed to validate the system's reliability:

- **Unit Testing**: Verified individual smart contract functions.
- **Integration Testing**: Assessed interactions between blockchain, IPFS, and the front-end.
- **Functional Testing**: Ensured all features met specified requirements.

## XII. CONCLUSION

The blockchain-based document verification system provides a scalable, secure, and efficient alternative to traditional methods. By leveraging blockchain's transparency and immutability, the system reduces fraud risks and eliminates manual inefficiencies. Future work includes integrating additional blockchain networks for cross-platform interoperability.

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