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Efficient paperless authentication of students using blockchain

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Abstract: This paper presents the implementation of an e-document verification system that utilizes blockchain technology and QR codes. The system ensures secure and tamper-proof verification of student documents while streamlining the application process for companies. The project is developed using XAPPM, Eclipse, and JDK. As scientific data grows exponentially, ensuring the quality of information and preventing data manipulation are becoming critical to validate research findings. Graduation certificates and academic transcripts contain sensitive information, requiring a system that guarantees both authenticity and confidentiality. This means the information must be proven to come from an authorized source without being easily accessible to unauthorized parties. Blockchain can help reduce instances of certificate forgery, improving the security, validity, and confidentiality of graduation certificates.

Key Words: E-document verification , QR codes , security, validity, confidentiality

1. Introduction Traditional document verification is time-consuming and prone to forgery. The proposed system provides an automated and secure method to verify student documents using blockchain and QR codes. The system includes three main stakeholders: students, companies, and the admin. By leveraging blockchain, the system ensures data integrity, transparency, and security while reducing administrative overhead.

Blockchain technology presents new opportunities for innovative business models in well-established sectors, and one of the most promising yet challenging areas is its application in education. The potential for secure, reliable, and cost-effective verification of official documents, like university degrees, makes blockchain a valuable solution in this field. Blockchain's stability and widespread adoption in various sectors support its use as a verification tool across multiple industries. However, choosing an appropriate public blockchain one that is accessible, flexible, and cost-effective is essential for creating a sustainable business model.

2.Body of Paper

2. System Architecture The architecture consists of the following components:

- **Student Module:** Allows students to upload documents and receive a QR code for verification. This module ensures that students have control over their credentials and can share them securely with potential employers.
- **Company Module:** Enables companies to scan QR codes and verify student credentials. This eliminates the need for lengthy manual verification processes.
- **Admin Module:** Manages users, verifies documents, and maintains blockchain integrity. The admin ensures that only authentic documents are stored and verified.
- **Blockchain Network:** Stores hashes of student documents for immutability and transparency. The decentralized nature of blockchain prevents tampering and fraud.
- **QR Code Generator:** Encodes document information and verification details, making the process efficient and user-friendly.

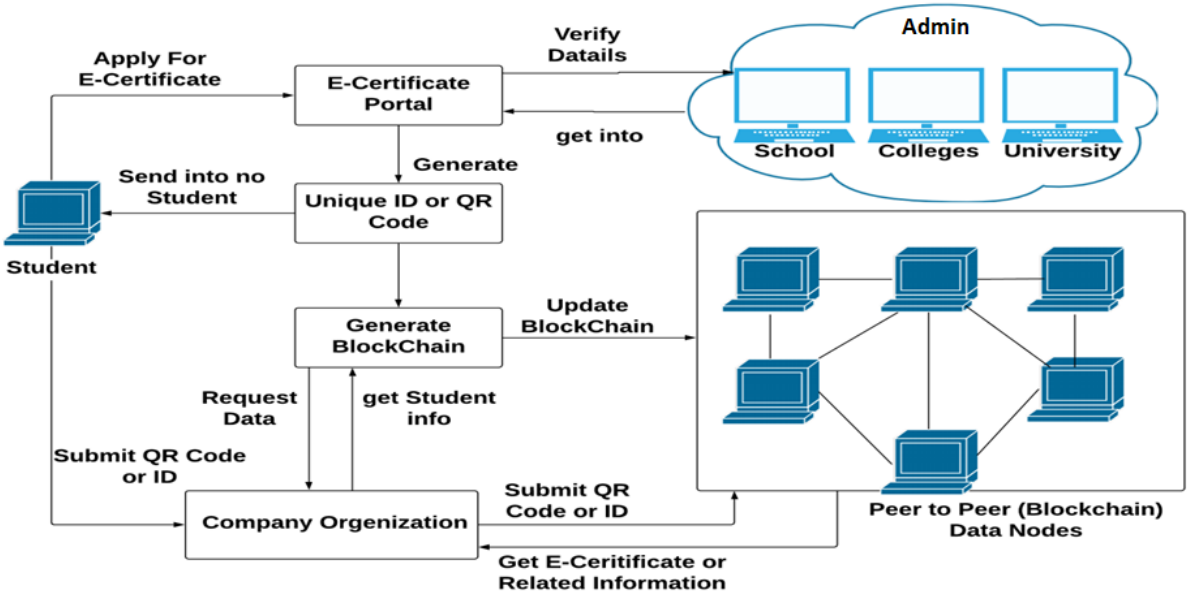


Fig -1: System Architecture

3. Technology Stack

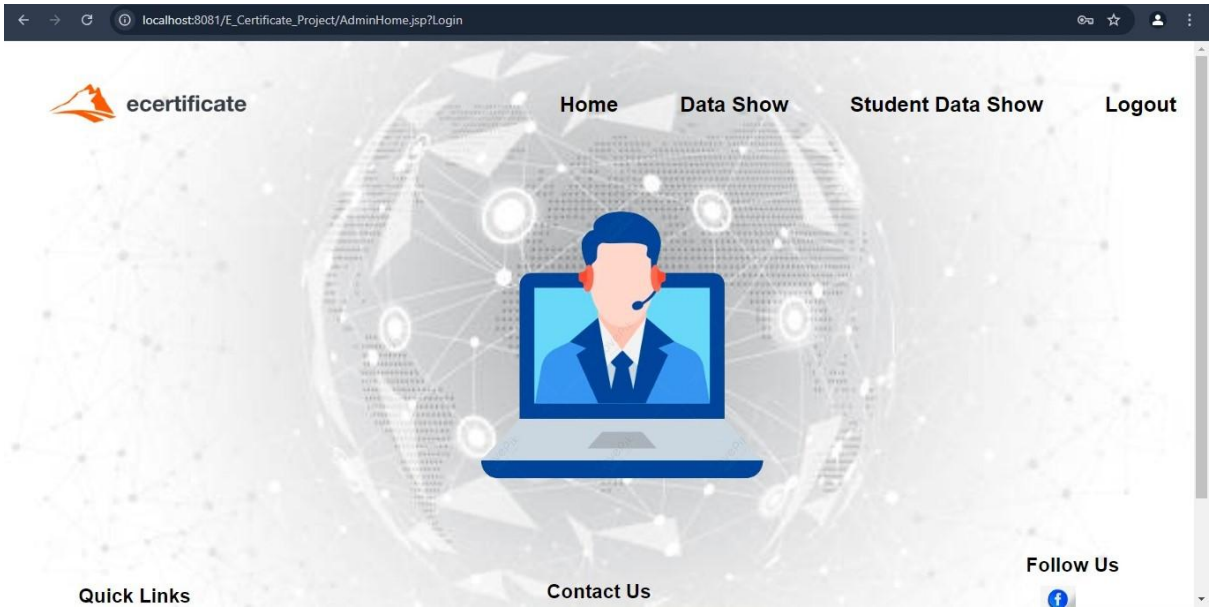
- **Development Tools:** XAPPM, Eclipse, JDK
- **Blockchain Framework:** Ethereum/Hyperledger Fabric
- **Database:** MySQL/PostgreSQL
- **QR Code Generator:** QRGen library
- **Smart Contracts:**Chaincode for Hyperledger Fabric

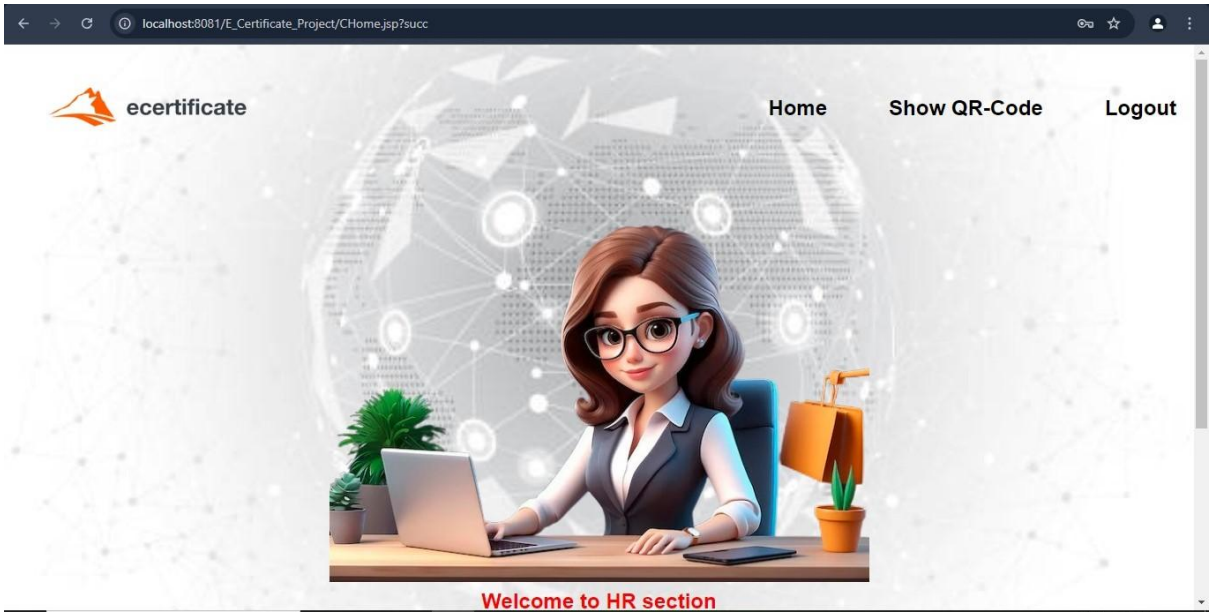
Aspect	Traditional Document Verification	QR Code-Based Blockchain Verification
Time Efficiency	Time-consuming; requires manual checks and verification.	Fast and automated; QR codes provide instant access to verified data.
Forgery Risk	High risk of document tampering or forgery.	Low risk; blockchain's immutability ensures data integrity.
Security	Prone to data breaches and unauthorized changes.	Highly secure; cryptographic hashing ensures tamper-proof records.
Verification Process	Requires contacting institutions, sending physical documents, or multiple emails.	Instant verification via QR code scan linked to blockchain data.
Cost	Higher costs due to manual labor, paperwork, and courier services.	Reduced costs as the process is digital and automated.
Transparency	Limited visibility; institutions may not disclose the entire verification process.	Full transparency; all transactions are traceable on the blockchain.
Scalability	Difficult to manage a large number of records efficiently.	Easily scalable for multiple students and institutions.

Aspect	Traditional Document Verification	QR Code-Based Blockchain Verification
Data Integrity	Records can be altered or lost.	Blockchain ensures data is immutable and traceable.
User Experience	Tedious and requires significant effort from students and companies.	Seamless and user-friendly; simple QR code scanning enables instant verification.
Environmental Impact	Often paper-based, contributing to environmental waste.	Eco-friendly; digital storage reduces paper usage.

4. Implementation Details

- **Student Registration and Document Upload:**
  - Students register on the platform and upload their academic documents.
  - The system generates a hash of the document and stores it on the blockchain.
  - A QR code is generated linking to the blockchain record.
- **Verification by Companies:**
  - Companies scan the QR code using the system.
  - The system retrieves the document hash from the blockchain and verifies integrity.
  - The verified document details are displayed to the company.
- **Admin Oversight:**
  - The admin monitors document uploads and ensures authenticity.
  - Any discrepancies in document verification trigger an alert, allowing corrective action.

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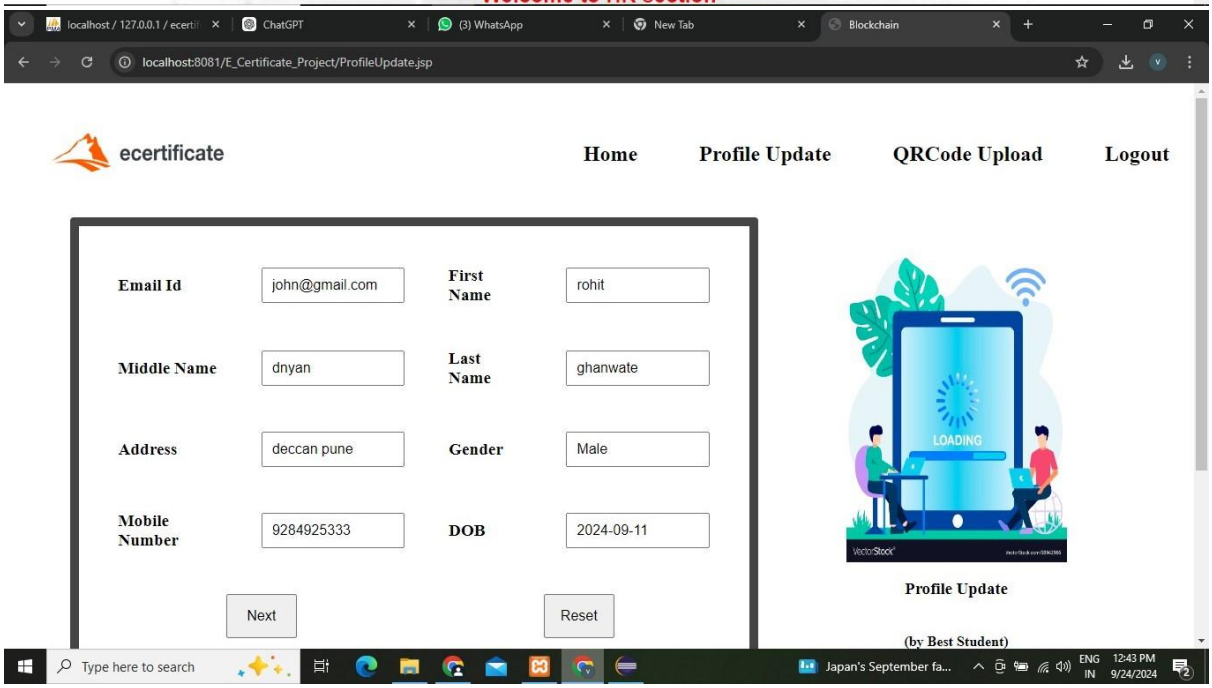
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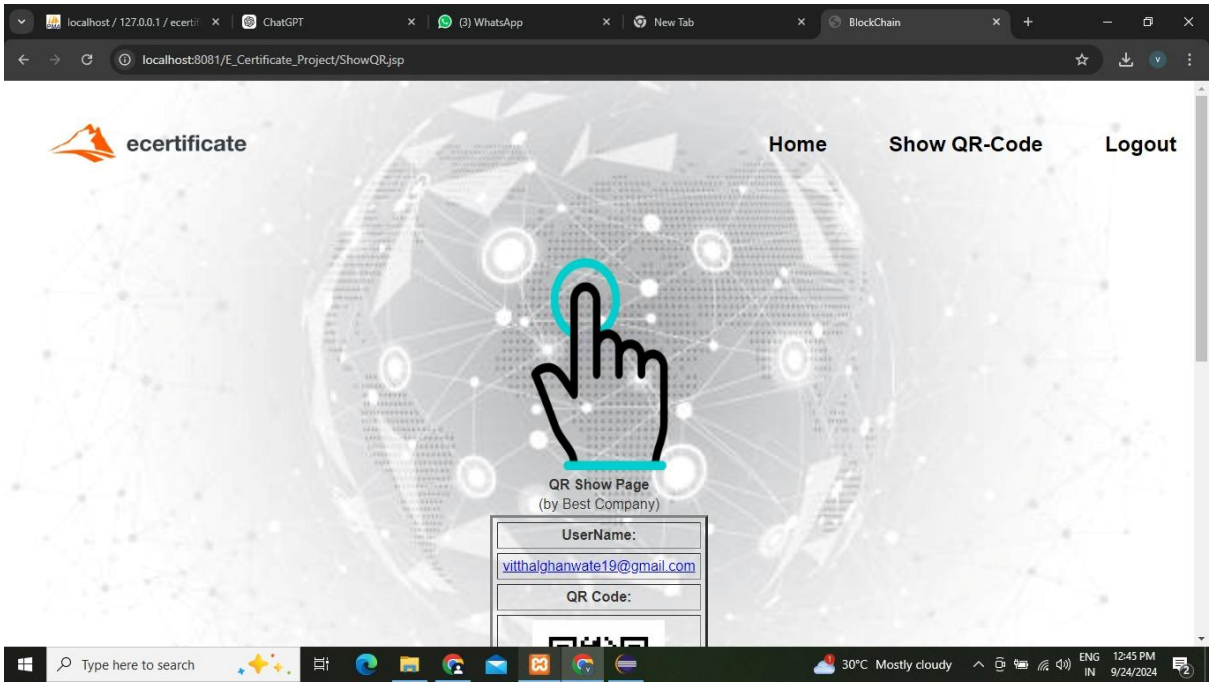
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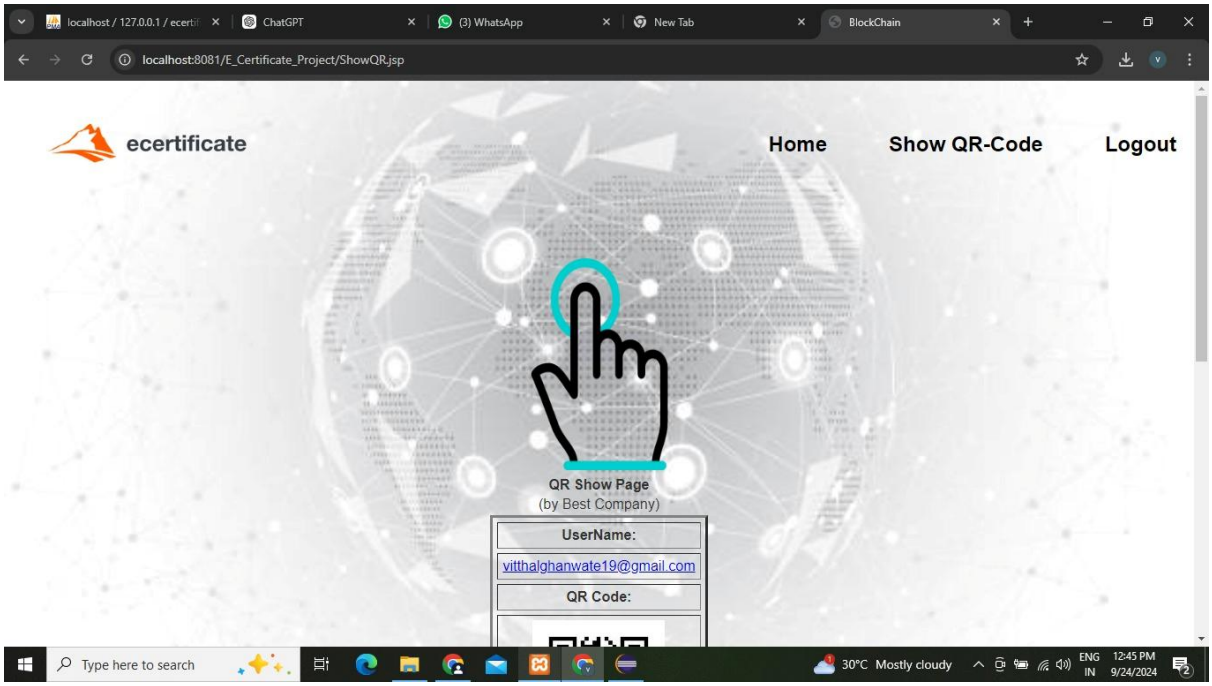
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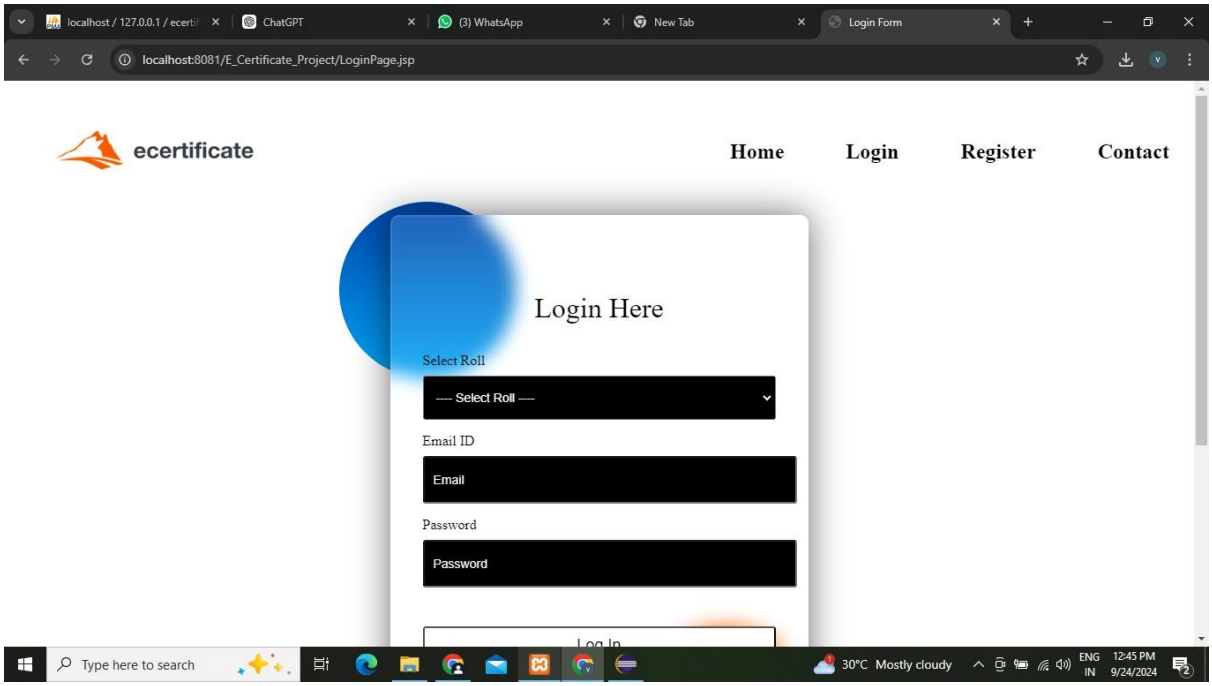
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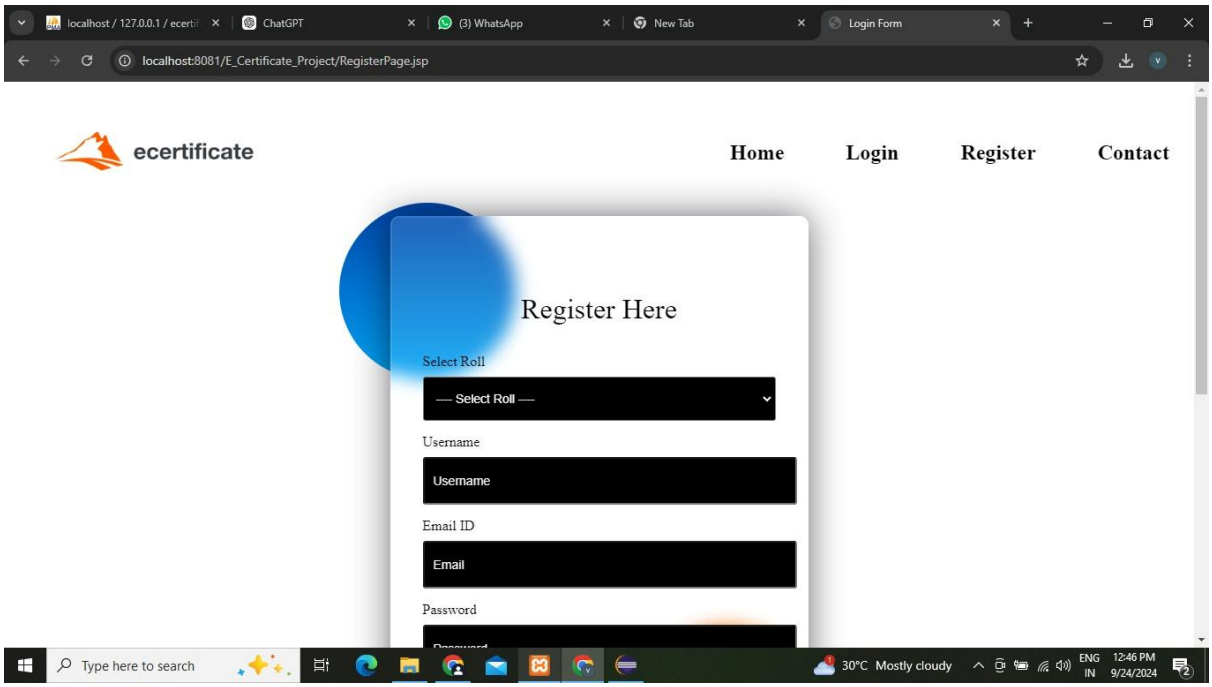
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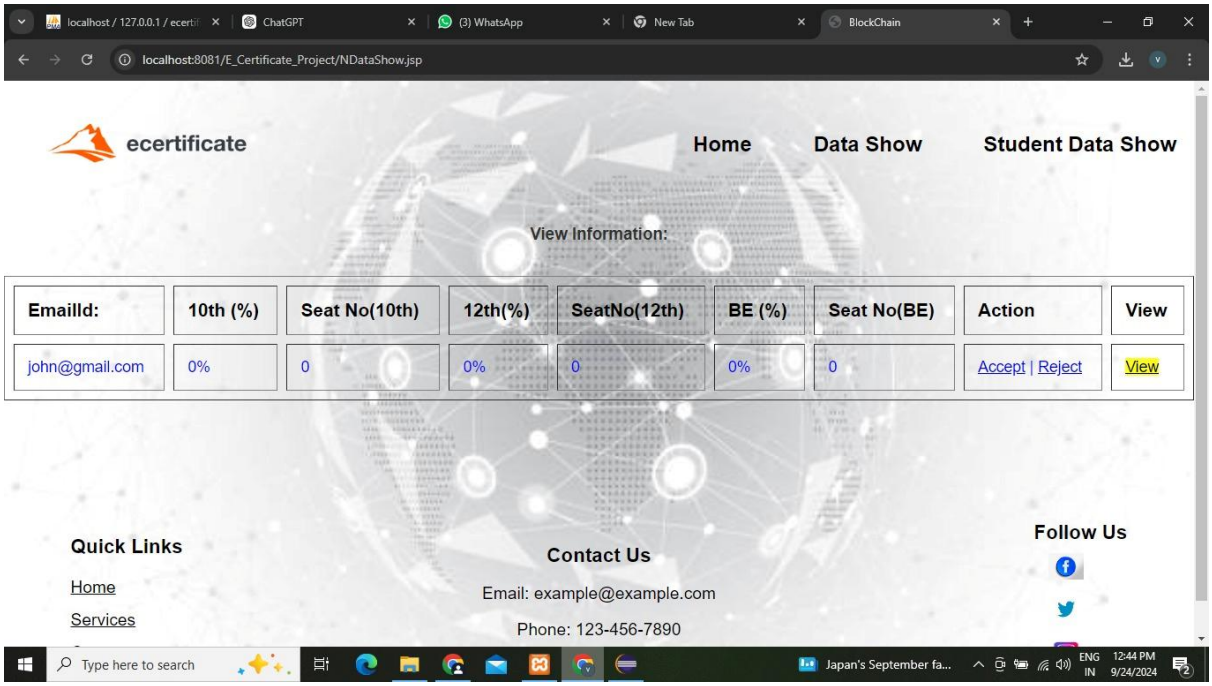
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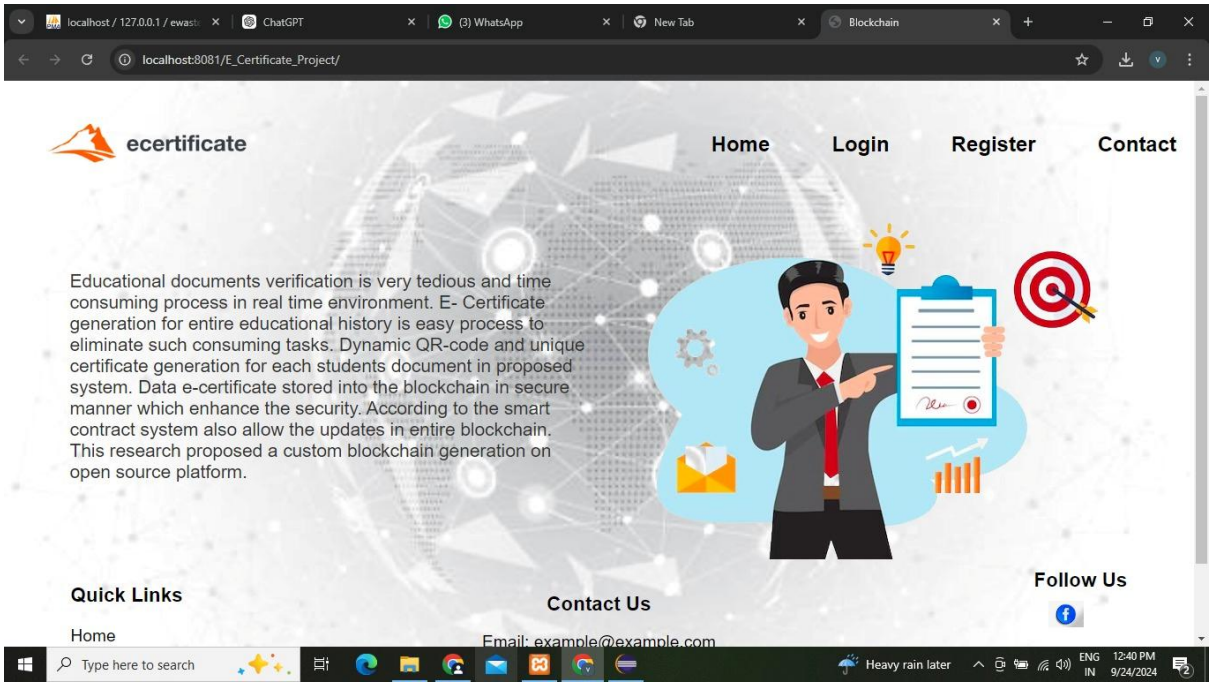
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Educational documents verification is very tedious and time consuming process in real time environment. E- Certificate generation for entire educational history is easy process to eliminate such consuming tasks. Dynamic QR-code and unique certificate generation for each students document in proposed system. Data e-certificate stored into the blockchain in secure manner which enhance the security. According to the smart contract system also allow the updates in entire blockchain. This research proposed a custom blockchain generation on open source platform.
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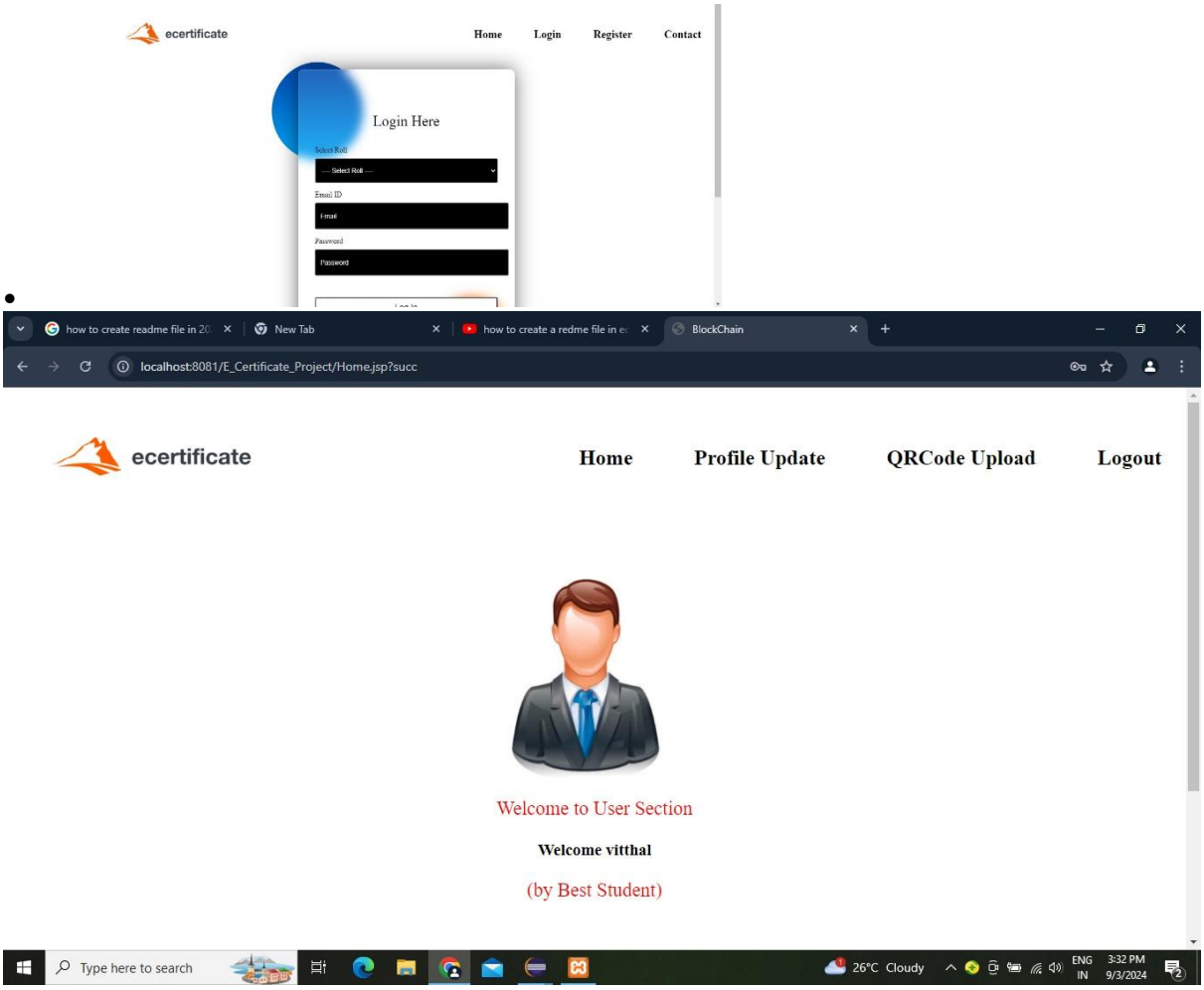

5. Security and Integrity Features

- **Blockchain Integration:** Ensures documents cannot be tampered with after registration, providing long-term security.
- **QR Code Verification:** Simplifies document validation without exposing private data, reducing the risk of unauthorized access.
- **Encryption and Access Control:** Secure student and company data using AES/RSA encryption, preventing unauthorized modifications.

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6. Advantages of the System

- **Prevents Document Forgery:** Immutable blockchain storage eliminates fake credentials, enhancing trust in academic qualifications.
- **Enhances Efficiency:** QR-based verification reduces processing time for companies, streamlining hiring processes.

- **Decentralized Trust:** Blockchain removes the need for third-party verification, making the process faster and more reliable.
- **User-Friendly Interface:** The system provides an intuitive UI for students and companies to interact seamlessly.
- **Scalability:** The system can be expanded to include multiple institutions and industries beyond academia.

7. Expected Outcomes

- **Increased Trust:** Employers and educational institutions can confidently verify documents without fear of tampering or fraud.
- **Reduction in Verification Time:** The automated process significantly reduces the time required for document validation.
- **Enhanced Security:** The combination of blockchain and encryption ensures a highly secure environment for document storage and retrieval.
- **Improved Student and Employer Experience:** A seamless verification process leads to a better experience for both students and recruiters.
- **Cost Efficiency:** Reducing the need for manual verification saves administrative costs for institutions and companies.
- **Scalable Solution:** The system can be adapted for use in other document verification scenarios, such as government and legal records.

Milestones and Timeline:

1. **Requirement Gathering and Analysis (2 weeks):**
   - Identify stakeholders and system requirements.
   - Define technical and functional specifications.
2. **Design and Planning (3 weeks):**
   - Design the system architecture (blockchain, smart contracts, QR code integration).
   - Select the open-source blockchain platform (e.g., Hyper ledger, Ethereal).
3. **Development Phase 1: Blockchain Setup (4 weeks):**
   - Configure the custom blockchain.
   - Implement and test basic smart contracts for certificate issuance.
4. **Development Phase 2: Certificate Generation (4 weeks):**
   - Develop the QR code generation module.
   - Integrate blockchain storage with certificate generation.
5. **Development Phase 3: Verification System (3 weeks):**
   - Build the verification interface for third-party access.
   - Develop a public-facing web portal or app for verification.
6. **Testing and Deployment (3 weeks):**
   - Conduct unit, integration, and performance testing.
   - Deploy the system on the selected infrastructure.
7. **Training and Documentation (2 weeks):**
   - Train users (educational institutions, employers).
   - Provide system documentation and user manuals.
8. **Maintenance and Updates (Ongoing):**
   - Monitor system performance and fix bugs.
   - Upgrade features based on feedback.

9. Conclusion The e-document verification system offers a robust, secure, and efficient method to validate student credentials. The integration of blockchain and QR codes provides a seamless process for students, companies, and administrators. Future enhancements may include AI-based document analysis, cross-institution verification, and further decentralization using advanced cryptographic techniques.

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