PowerLedger

GRADE SHEET MONITORING

B.Tech. III Year I Semester - Project Report

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Abstract

This project aims to develop a **Decentralized Application (DApp)** for grade sheet monitoring using **blockchain technology**, ensuring transparency, immutability, and security in academic records. The DApp automates the process of uploading, verifying, and accessing student grades, reducing manual intervention and eliminating tampering risks.

Solidity is used to write smart contracts that store and manage the grade data, while **Ganache** serves as the local blockchain environment. **MetaMask** is integrated for secure user authentication and transaction management. The DApp features a user-friendly interface for seamless interaction among students, faculty, and administrators.

This project highlights blockchain's potential in educational management by providing a tamper-proof, decentralized repository for academic records. The architecture can be extended to manage certifications, attendance, or even course registrations, demonstrating its versatility in academic applications.

Literature Review: Grade Sheet Monitoring System DApp

Traditional Grade Management Systems and Their Limitations

Conventional grade management systems rely heavily on centralized databases and manual record-keeping, leading to several issues:

- **Human errors** during data entry and updates.
- **Lack of transparency** for students to verify grades.
- **Vulnerability to tampering** or unauthorized access, compromising data integrity.
- **Centralized control**, making systems susceptible to cyberattacks and data loss.

These limitations highlight the need for a secure, tamper-proof, and transparent system for managing academic records.

Role of Blockchain in Academic Record Management

Blockchain offers a decentralized platform ideal for managing sensitive academic data. Key benefits include:

- **Transparency:** All grade entries are recorded publicly (with privacy controls), ensuring accountability.
- **Immutability:** Once recorded, data cannot be altered, preventing grade tampering.

- **Automation:** Smart contracts automate grade submissions and verification processes, reducing administrative overhead.
- **Decentralization:** Eliminates the need for centralized control, distributing trust across the network.

Similar Decentralized Applications (DApps)

Several blockchain-based projects have tackled academic credential verification:

- **Blockcerts:** Focuses on issuing and verifying digital academic certificates.
- **EduChain:** Manages academic records using blockchain for enhanced transparency.

However, these projects often focus on credentials rather than real-time grade monitoring. This DApp addresses that gap by providing continuous monitoring and updates, with a focus on user accessibility.

Introduction

Problem Background

Managing academic grades traditionally involves manual processes that are prone to errors and fraud. Centralized grade storage systems are vulnerable to hacking and lack the transparency required for students to verify their records independently. Therefore, a secure, transparent, and automated system is essential.

Objective

The primary objective is to develop a **DApp** for grade sheet monitoring that:

- **Automates grade entry and updates** by faculty.
- **Ensures immutable storage** of grades.
- **Allows students to access and verify** their grades securely.

Scope

This project will be validated in a local blockchain environment, focusing on:

- **Ganache** as a local blockchain for testing.
- **MetaMask** for secure login and transaction signing.
  The proof-of-concept will demonstrate feasibility before real-world deployment.

Brief Overview

The DApp will utilize **Solidity** for writing smart contracts that automate grade management. A user-friendly frontend will enable students and faculty to interact seamlessly with the blockchain via **MetaMask**.

Main Findings

- Automates grade recording, minimizing manual errors.
- Enhances transparency and trust through blockchain immutability.
- Local testing shows the system's potential for scalability and real-world deployment.

Architectural Design of the DApp

Components of the Architecture

1. **Frontend (User Interface)**
    - **Technology:** HTML, CSS, JavaScript
    - **Purpose:**
        - Provide an intuitive interface for entering and viewing grades.
        - Facilitate MetaMask integration for blockchain interactions.
2. **Blockchain Layer**
    - **Smart Contracts:**
        - Written in **Solidity** to store, update, and retrieve grades securely.
    - **Data Handling:**
        - Ensures immutable storage of grades and transaction history on the blockchain.
3. **Wallet Integration**
    - **MetaMask:**
        - Manages user authentication and transaction signing.
        - Secures user interactions with the blockchain.

4. **Local Blockchain Simulation**
   - **Ganache:**
     - Provides a local blockchain for deploying and testing smart contracts.
     - Simulates blockchain transactions in a controlled environment.

Workflow

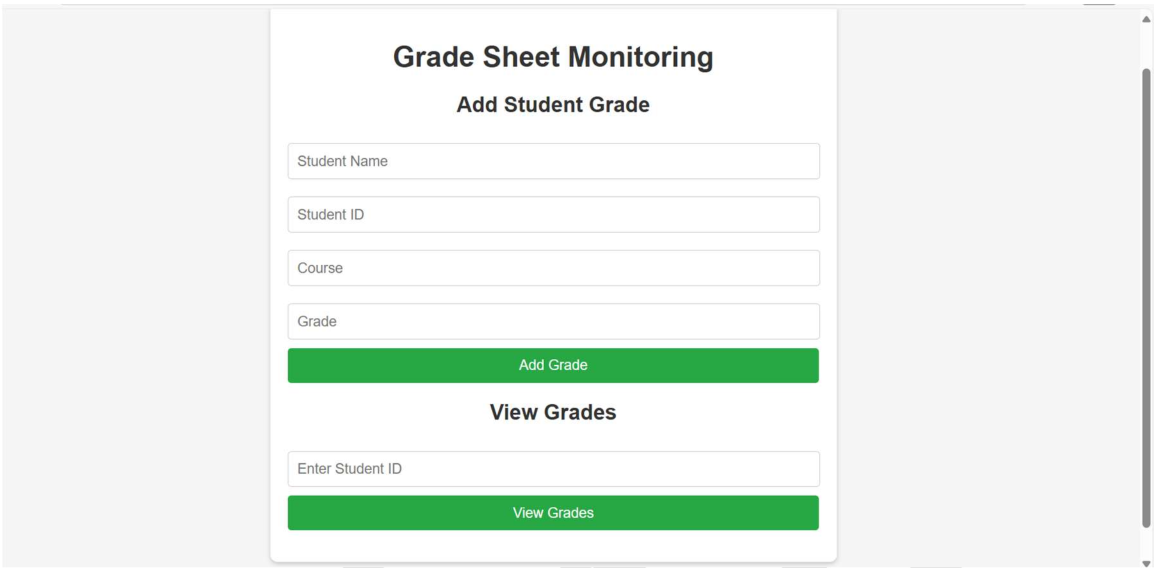
1. **User Interaction**
   - Users log in via MetaMask.
   - Faculty enters grades, and students view their grade sheets through the frontend.
2. **Data Processing**
   - Smart contracts handle grade storage and updates on the blockchain.
3. **Grade Display**
   - Retrieved grades are displayed on the user interface in real time.

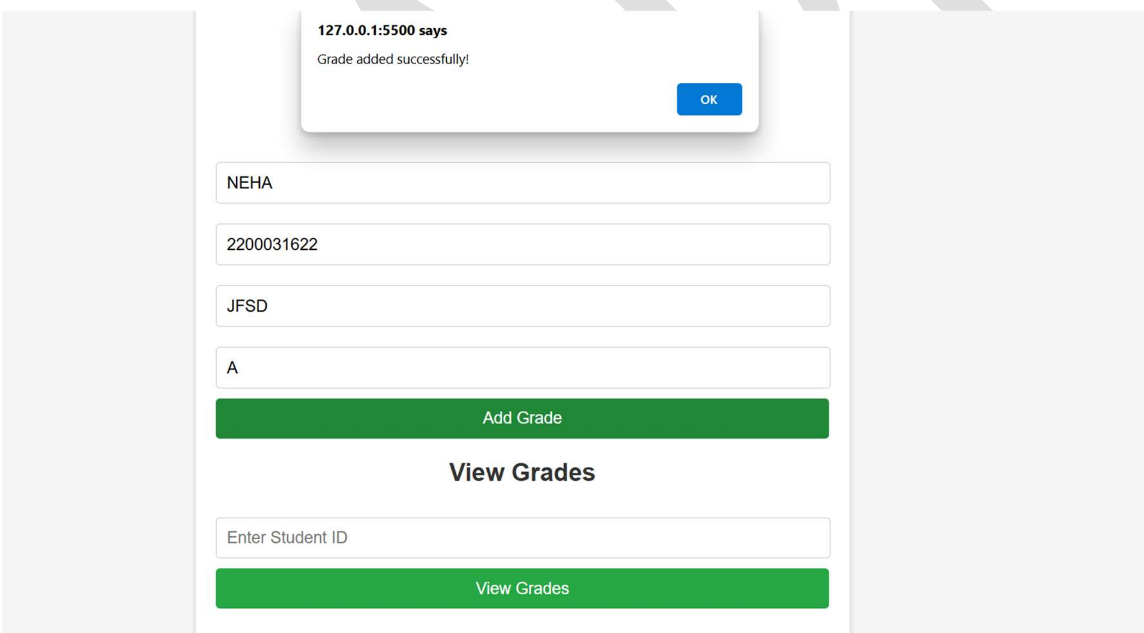
Smart Contract Design

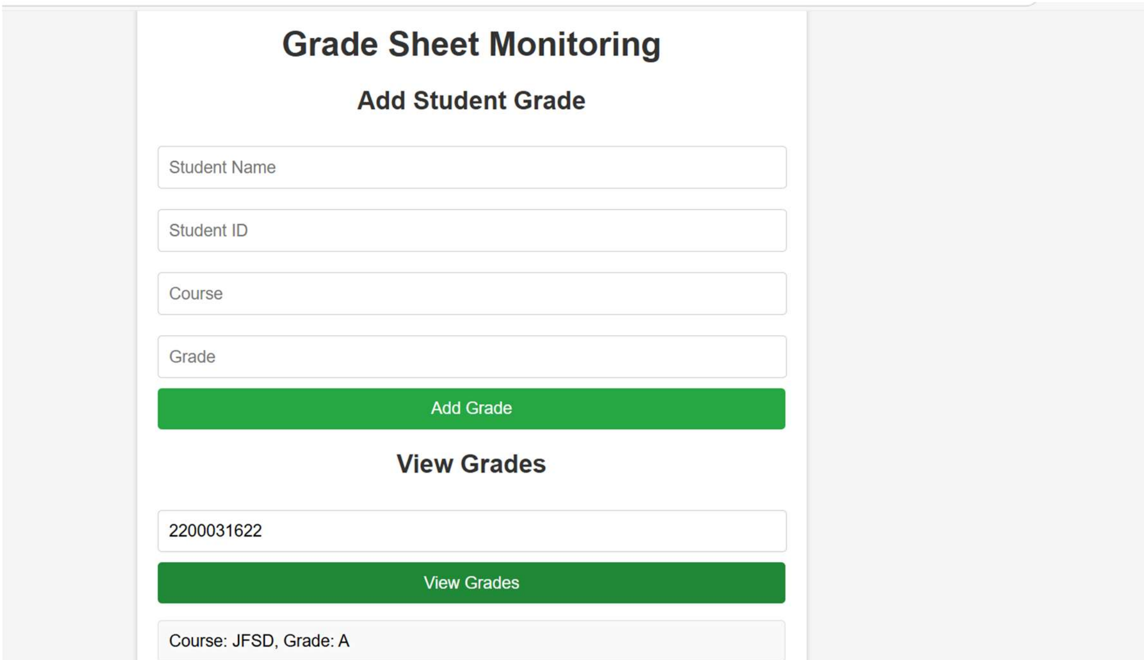
Key functions in the smart contract:

- **setGrades(uint studentId, uint courseId, uint grade):** Stores the grade for a student in a specific course.
- **getGrades(uint studentId):** Retrieves the grades of a student.

Implementation







Challenges and Limitations

Challenges Faced During MetaMask Integration

- **User Authentication**: Ensuring secure connection between the MetaMask wallet and the DApp was challenging, especially in managing private keys securely.
- **Transaction Errors**: Debugging failed transactions due to gas limit issues or smart contract errors required meticulous testing and optimization.
- **Cross-Browser Compatibility**: Ensuring smooth MetaMask integration across different browsers and devices added complexity to the development process.

Limitations of Local Simulation Using Ganache

- **Scalability**: Ganache provides a controlled environment but does not replicate the latency or network conditions of a public blockchain.

- **Security Testing**: The simulation lacks real-world security threats, making it less effective in identifying vulnerabilities.
- **Limited Nodes**: A local blockchain setup does not simulate the decentralized nature of public networks, impacting reliability testing.

Potential Issues in Scaling to a Public Blockchain

- **High Gas Fees**: Deploying and interacting with smart contracts on Ethereum can incur significant costs.
- **Network Congestion**: Public blockchain networks may experience delays during peak activity.
- **Adoption Challenges**: Convincing utility companies and users to adopt blockchain-based systems requires addressing technical and non-technical concerns.

FUTURE SCOPE

1. **Deployment on Live Networks**
    - Transitioning the DApp to a live blockchain like **Ethereum** or **Polygon**, offering real-world utility and greater security.
2. **Historical Data Recording**
    - Enhancing the DApp to record and display **historical usage and grading data**, enabling users to track trends and manage consumption effectively.
3. **Improved User Interface**
    - Designing a more intuitive and visually appealing UI to enhance the user experience.
    - Adding support for additional utilities such as **giving sum of grades, giving averages.**

Conclusion

The project successfully achieved its primary objective of creating a secure and transparent grade monitoring system using blockchain technology. By leveraging the **immutability** and **automation** of smart contracts, the DApp ensures accurate and eliminates common issues in traditional systems.

The use of blockchain decentralization not only enhances trust and transparency but also showcases the transformative potential of emerging technologies in utility management. With further refinements, the DApp has the potential to revolutionize utility billing on a global scale.

References

- Ethereum Documentation - https://ethereum.org/
- Solidity Documentation - https://soliditylang.org/
- MetaMask Developer Guide - https://metamask.io/
- Ganache Documentation - https://trufflesuite.com/ganache/