SMART ACADEMIC MANAGEMENT SYSTEM USING AI RECOMMENDATION AND BLOCKCHAIN SECURITY

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Abstract

This paper will represent the modern design and development of a student portal that incorporates blockchain-based verification, a skill recommendation engine, and behaviour analysis. Mainly, this system aims to create transparency between the student and the teacher, and improve personalisation of a student and academic tracking. The blockchain module helps with the tamper- proof certificates, while the recommendation system suggests relevant skills based on the performance of a student. Additionally, behaviour analysis is used to monitor the student performance and academic trends. The proposed system provides a scalable and user-friendly solution that bridges the gap between academic data management and intelligent decision-making. The main aim of this system is used to reduce the gap between the teacher and student.

Keywords: ***Blockchain, Student portal, Skill Recommendation, Artificial Intelligence, Behavior Analysis***.

I. Introduction

In recent years, educational institutions have increasingly adopted digital platforms for managing student data. However, traditional systems lack intelligent insights and secure verification mechanisms. Issues such as certificate forgery, lack of personalised guidance, and insufficient monitoring of student behaviour remain prevalent.

This paper proposes an integrated system that combines blockchain technology, artificial intelligence, and data analytics to address these challenges. The system is designed to provide secure credential verification, personalised skill recommendations, and real-time behavioural insights.

To address these challenges, this project proposes an integrated student portal that combines intelligent analytics with secure verification mechanisms. The
The system is designed to enhance the overall academic ecosystem by incorporating three key functionalities: blockchain-based credential verification, skill recommendation, and student behaviour analysis.

The blockchain component ensures the authenticity and integrity of academic certificates by generating and validating unique cryptographic hashes, thereby reducing the risk of tampering and fraudulent claims. In addition, the skill recommendation module analyses student performance and learning patterns to suggest relevant skills and career-oriented paths, helping students make informed decisions about their future development.

Furthermore, the behaviour analysis module tracks user activity such as login frequency, assignment submission patterns, and academic performance trends. By analysing this data, the system provides meaningful insights into student engagement and identifies potential areas of improvement.

The proposed system aims to move beyond conventional student portals by integrating modern technologies such as data analytics and secure verification techniques into a unified platform. This approach not only improves transparency and reliability but also supports personalized learning and academic growth.

Mainly this system used to increase the personality of a student and interaction between the student and the teacher.AI insights are used to analyse the behaviour of a student and performance of a student and skills of a student gradually with time.

The Existing system didn't had any of these feature a student can't improve himself without any guidance, so , the proposed system is used to analyse his behaviour and his performance gradually overtime, it is also used to select a skill according to the interest of subject of a student. It analyse the semester marks of student and give the match percentage of a skill to a students.

II. RELATED WORK

Several research efforts have focused on improving academic management systems through the use of emerging technologies such as blockchain, machine learning, and data analytics. Traditional student information systems primarily store academic data but often lack security, transparency, and intelligent decision-making capabilities.

Blockchain technology has been widely explored for secure academic record management. Many studies propose decentralized systems for certificate verification, where academic credentials are stored on a distributed ledger. This approach ensures data integrity, prevents unauthorized modifications, and simplifies the verification process for institutions and employers. However, most existing solutions focus only on certification and do not integrate additional features such as student performance analysis or recommendations.

In the area of recommendation systems, researchers have developed models to suggest courses, learning paths, and skill enhancements based on student data. These systems typically use machine learning algorithms to analyze academic performance and predict suitable areas for improvement. While effective, many of these systems operate independently and are not integrated into a unified student portal.

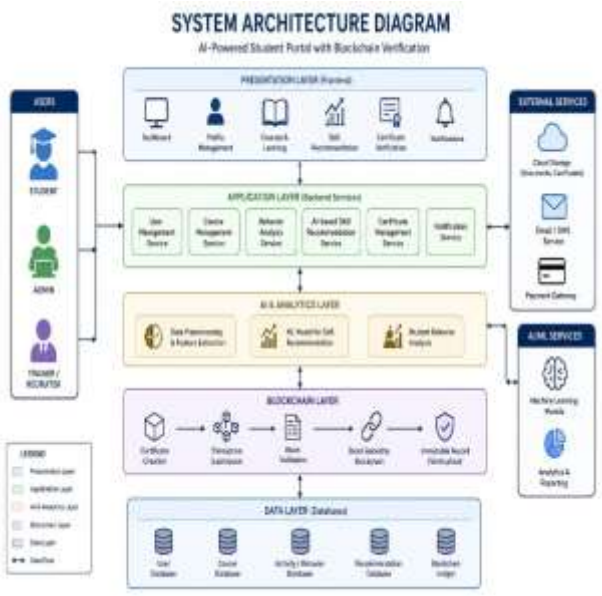
Behaviour analysis in education has also gained attention, particularly with the rise of learning analytics. Existing studies utilize student activity data, attendance records, and assessment results to identify patterns in learning behaviour. These insights help educators detect at-risk students and improve teaching strategies. However, such systems often lack real-time analysis and personalized feedback mechanisms.

Despite these advancements, there is a noticeable gap in integrating blockchain-based verification, skill recommendation, and behaviour analysis into a single platform. Most existing systems address only one or two aspects, resulting in fragmented solutions.

The proposed system aims to overcome these limitations by combining secure data management, intelligent recommendations, and behavioural insights into a unified student portal, thereby providing a more comprehensive and efficient academic management solution.

III. SYSTEM ARCHITECTURE

The proposed system is designed using a modular and layered architecture to ensure scalability, security, and efficient data processing. It integrates blockchain technology, a skill recommendation engine, and behaviour analysis into a unified student portal. The architecture is divided into multiple layers, each responsible for specific functionalities**.**



A. Overview

The system architecture consists of four main layers: the User Interface Layer, Application Layer, Data Processing Layer, and Blockchain Layer. These layers interact with each other to provide seamless data flow and efficient system performance.

B. User Interface Layer

The User Interface (UI) layer provides interaction between users and the system. It includes separate dashboards for students and teachers. Students can view their academic performance, skill recommendations, and certificates, while teachers can monitor student progress, upload records, and provide feedback. The interface is designed to be responsive and user-friendly.

C. Application Layer

The application layer acts as the core component of the system, handling all business logic and communication between modules. It includes:

- User authentication and authorization
- Academic record management
- API handling and request processing

This layer ensures secure access and proper functioning of the system.

D. Data Processing Layer

The data processing layer is responsible for analyzing student data and generating insights. It consists of:

- Skill Recommendation Engine: Analyzes academic performance and suggests relevant skills or learning paths.
- Behaviour Analysis Module: Evaluates student engagement, attendance, and performance trends to identify strengths and weaknesses.

This layer may use rule-based methods or machine learning algorithms for analysis.

E. Blockchain Layer

The blockchain layer is used to securely store and verify academic records and certificates. Each record is stored as an immutable block, ensuring data integrity and preventing unauthorized changes. Verification can be performed efficiently without relying on a central authority, increasing trust and transparency.

F. Database Layer

The database layer stores structured data such as student records, performance data, and system logs. It supports efficient data retrieval and works in coordination with the application and data processing layers.

G. Data Flow

The system follows a structured data flow:

1. **Users interact with the system through the UI layer**
2. **Requests are processed in the application layer**
3. **Data is analyzed in the data processing layer**
4. **Verified records are stored in the blockchain layer**
5. **Results and insights are displayed to users**

IV. METHODOLOGY

The proposed system follows a structured methodology to design and implement an intelligent student portal integrating blockchain verification, skill recommendation, and behaviour analysis. The development process is divided into multiple stages to ensure efficiency, accuracy, and scalability.

4.1 Data Collection

The system collects data from various sources such as:

- Student academic records (marks, grades)
- Attendance details
- Assignment and activity performance

This data serves as the foundation for analysis and recommendations.

4.2 Data Preprocessing

Before analysis, the collected data is cleaned and organized.

- Removal of incomplete or inconsistent records
- Normalization of data for uniformity
- Structuring data into usable formats

This step ensures accurate and reliable results.

4.3 Blockchain Integration

Academic records and certificates are securely stored using blockchain technology.

- Each record is converted into a block
- Data is encrypted and linked to previous blocks
- Once stored, the data becomes immutable

This ensures data integrity and prevents unauthorized modifications.

4.4 Skill Recommendation Process

The system analyzes student performance to suggest relevant skills.

- Performance metrics such as marks and participation are evaluated
- Based on predefined rules or algorithms, suitable skills are recommended
- Recommendations help students improve in weak areas

This module enhances personalized learning**.**

4.5 Behaviour Analysis

Behaviour analysis is performed to understand student learning patterns.

- Tracks consistency, engagement, and progress over time
- Identifies trends such as improvement or decline in performance
- Helps teachers provide targeted support

4.6 System Implementation

The system is developed using web technologies:

- Frontend: HTML, CSS, JavaScript
- Backend: (e.g., Node.js / Python / PHP)
- Database: MySQL or similar
- Blockchain: Lightweight or simulated blockchain for academic use

Modules are integrated to ensure smooth communication between components.

4.7 Output Generation

The system provides outputs in the form of:

- Student dashboards with performance insights
- Skill recommendations
- Verified digital certificates
- Reports for teachers

4.8 Evaluation

The system is evaluated based on:

- Accuracy of recommendations
- Security of stored data
- User experience and performance

V. DATASET

The performance of the proposed system is evaluated using a structured dataset that represents student academic and behavioural information. The dataset is designed to simulate real-world educational data and supports analysis, recommendation, and verification processes.

5.1 Dataset Description

The dataset consists of multiple attributes related to student performance and activities, including:

- Student ID
- Name and basic details
- Subject-wise marks
- Attendance percentage
- Assignment and project scores
- Participation in extracurricular activities

This data is used to analyze academic performance and generate meaningful insights.

5.2 Data Source

The dataset can be obtained from:

- Institutional academic records (if available)
- Sample or synthetic datasets created for testing
- Public educational datasets (for research purposes)

For this project, a sample dataset is used to demonstrate system functionality.

5.3 Data Format

The dataset is stored in a structured format such as:

- CSV (Comma-Separated Values)
- Database tables (MySQL or similar)

Each row represents a student, and each column represents a specific attribute.

5.4 Features Used

The following features are primarily used in the system:

- **Academic Features:** Marks, grades, subject performance
- **Behavioural Features:** Attendance, consistency, participation
- **Performance Indicators:** Overall score, improvement trends

These features are essential for both recommendation and behaviour analysis modules.

5.5 Data Usage in the System

- **Skill Recommendation:** Uses performance data to suggest relevant skills
- **Behaviour Analysis:** Identifies trends and learning patterns
- **Blockchain Module:** Stores verified certificates and key records

5.6 Data Privacy and Security

To ensure data protection:

- Sensitive information is encrypted
- Access is restricted to authorized users
- Blockchain ensures tamper-proof storage of critical data

5.7 Limitations of Dataset

- Sample dataset may not fully represent real-world complexity
- Limited size may affect accuracy of analysis
- Requires continuous updates for better performance

VII. DISCUSSION

The proposed student portal demonstrates how the integration of modern technologies such as blockchain, recommendation systems, and behaviour analysis can significantly improve academic management. The system not only enhances data security but also introduces intelligent features that support both students and educators.

One of the key strengths of the system is the use of blockchain technology for certificate verification. Unlike traditional storage methods, blockchain ensures that academic records are tamper-proof and easily verifiable. This reduces the chances of fraud and increases trust among institutions, students, and potential employers.

The skill recommendation module adds a layer of personalization by analyzing student performance and suggesting areas for improvement. This helps students focus on developing relevant skills rather than relying solely on academic scores. However, the accuracy of recommendations depends on the quality and size of the dataset. With limited data, the suggestions may not always be highly precise.

Behaviour analysis provides valuable insights into student learning patterns. By tracking attendance, consistency, and performance trends, the system enables teachers to identify students who may need additional support. This can lead to more effective teaching strategies and improved learning outcomes. At the same time, continuous monitoring may raise concerns about data privacy, which must be addressed through proper security measures.

Despite its advantages, the system also has certain limitations. The integration of multiple technologies increases system complexity and may require higher computational resources. Additionally, implementing blockchain in real-world academic environments may involve challenges such as scalability and adoption.

Overall, the proposed system offers a comprehensive solution that bridges the gap

between students and teachers by combining secure data management with intelligent analysis. With further improvements and real-world deployment, the system has the potential to transform traditional educational practices into a more efficient and data-driven approach.

VIII. CONCLUSION AND FUTURE WORK

This paper presented the design and development of an intelligent student portal that integrates blockchain-based verification, a skill recommendation system, and behaviour analysis. The proposed system addresses key limitations of traditional academic management systems by improving transparency, security, and personalization.

The use of blockchain technology ensures that academic records and certificates are secure, tamper-proof, and easily verifiable. The recommendation module supports students in identifying relevant skills based on their performance, promoting continuous improvement. Additionally, behaviour analysis provides valuable insights into learning patterns, enabling teachers to monitor progress and offer targeted guidance.

Overall, the system creates a more efficient and interactive academic environment by bridging the gap between students and teachers while supporting data-driven decision-making.

7.2 Future Work

Although the proposed system provides a strong foundation, several enhancements can be implemented in the future:

- **Integration of Advanced AI Models:** Incorporating machine learning and deep learning techniques can improve the accuracy of skill recommendations and behaviour predictions.
- **Mobile Application Development:** Developing a mobile-friendly version of the system will increase accessibility and user engagement.
- **Real-Time Analytics:** Implementing real-time data processing can provide instant feedback to students and teachers.
- **Scalability Improvements:** Optimizing the system to handle large-scale institutional data efficiently.
- **Integration with External Platforms:** Linking the system with online learning platforms and certification providers for broader functionality.
- **Enhanced Data Privacy Measures:** Implementing advanced encryption and compliance with data protection standards.

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