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Log Connect: A Smart Academic Connectivity and Management Application

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Abstract : *The Smart Curriculum, Academic Activity and Attendance Management System is a mobile-based application designed to simplify academic management and improve coordination between students, faculty members, and department administration. Traditional academic systems often manage attendance, assignments, curriculum progress, study materials, and student performance separately, making academic activities difficult to monitor efficiently. The proposed system provides an integrated platform that combines dynamic QR-based attendance, curriculum tracking, assignment management, digital learning resources, academic activity monitoring, and AI-powered assistance. It supports three main user roles: Student, Faculty, and Head of Department (HOD). Students can view subject-wise attendance, calculate required attendance, access study materials, submit assignments, track academic progress, and receive academic notifications. Faculty members can manage lectures, generate dynamic QR codes, upload learning resources, create assignments, evaluate submissions, and monitor student performance. HODs can manage departmental activities, monitor curriculum completion, allocate faculty responsibilities, and analyze attendance and academic reports. The system also incorporates machine learning techniques such as Random Forest and Logistic Regression to identify students at attendance risk and predict academic performance. A rule-based recommendation mechanism provides personalized academic suggestions, while an AI-powered assistant helps students with academic queries using relevant student information. The application is developed using React Native and TypeScript for the mobile interface, Python FastAPI for backend services, and Supabase PostgreSQL for database management, authentication, storage, and real-time updates. The proposed system aims to improve academic transparency, reduce manual administrative work, enhance communication, and support timely academic intervention through intelligent analysis. Its performance can be evaluated through functional testing, attendance verification accuracy, prediction results, assignment management efficiency, API response time, and user feedback.*

Keywords: Smart Academic Management, Attendance Management, Dynamic QR Code, Curriculum Tracking, Assignment Management, Digital Learning Resources, Machine Learning, Random Forest, Logistic Regression, Academic Performance Prediction, Artificial Intelligence, React Native, FastAPI, Supabase.

I. INTRODUCTION

The management of academic activities in educational institutions involves several interconnected processes, including student attendance, curriculum completion, assignment submission, study material distribution, and academic performance monitoring. In many institutions, these activities are handled through separate platforms or manual procedures, which can create difficulties in maintaining accurate records, accessing academic information, and monitoring student progress. Such fragmented systems may also increase the administrative workload of faculty

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members and department administrators. These challenges highlight the need for an integrated digital platform that can simplify academic operations and provide centralized access to essential academic information.

The proposed Smart Curriculum, Academic Activity and Attendance Management System is designed to provide a unified mobile-based solution for students, faculty members, and Heads of Departments (HODs). The application integrates dynamic QR-based attendance management, curriculum tracking, assignment creation and submission, digital study material management, practical activities, and academic performance monitoring. Students can access subject-wise attendance records, calculate the attendance required to meet institutional requirements, submit assignments, view learning resources, and monitor their academic progress. Faculty members can manage lectures, generate dynamic QR codes, upload study materials, evaluate assignments, and track student performance. HODs can monitor departmental activities, curriculum completion, faculty responsibilities, and academic reports through a centralized administrative interface.

In addition to conventional academic management functionalities, the system incorporates Artificial Intelligence and Machine Learning techniques to support academic decision-making. Machine learning algorithms such as Random Forest and Logistic Regression are considered for identifying students at risk of attendance shortages and analyzing academic performance. A rule-based recommendation mechanism can provide suggestions based on attendance and academic progress, while an AI-powered academic assistant helps students access relevant academic information. The application uses React Native and TypeScript for mobile development, Python FastAPI for backend services, and Supabase PostgreSQL for database management, authentication, file storage, and real-time updates. However, effective implementation requires attention to secure access, reliable attendance verification, accurate predictions, and efficient handling of academic data.

The main contributions of this paper are:

- A structured design of an integrated academic management platform combining attendance, curriculum tracking, assignments, and learning resources.
- A role-based system supporting students, faculty members, and HODs with dedicated academic management functionalities.
- An examination of dynamic QR-based attendance verification and student attendance monitoring mechanisms.
- An analysis of AI and machine learning applications for attendance-risk identification, academic performance prediction, and personalized recommendations.
- A modular mobile application architecture integrating React Native, FastAPI, and Supabase services.

The remainder of the paper is organised as follows. Section II reviews related work. Section III presents the proposed system architecture and methodology. Section IV discusses the system implementation and major functionalities. Section V presents the results and evaluation. Section VI concludes the paper and identifies future enhancements.

II. RELATED WORK

A. Academic Management Systems

Existing academic management systems provide digital solutions for handling student information, attendance records, course details, and institutional activities. These systems help educational institutions reduce manual record-keeping and improve access to academic information. However, several traditional platforms focus mainly on administrative operations and may not provide an integrated environment for curriculum tracking, assignment management, learning resources, and intelligent academic monitoring.

B. QR-Based Attendance Management

QR code technology has been widely adopted for digital attendance management because it provides a convenient method of identifying and recording student attendance. QR-based systems reduce the need for manual attendance registers and simplify lecture-wise attendance collection. However, static QR codes may be shared or reused by

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unauthorized students. Dynamic, session-specific QR codes combined with cryptographic verification can improve attendance security and reduce the possibility of fraudulent attendance marking.

C. Digital Learning and Assignment Management

Digital learning platforms provide facilities for distributing study materials, creating assignments, collecting submissions, and evaluating student work. These platforms improve communication between students and faculty members by providing centralized access to educational resources. However, when attendance records, curriculum progress, and academic performance are maintained separately, students and faculty may face difficulties in obtaining a complete view of academic progress. Integrating these functionalities into a single platform can improve academic coordination and monitoring.

D. Artificial Intelligence in Academic Performance Monitoring

Machine learning techniques have been explored for analyzing student academic performance and identifying learners who may require additional support. Algorithms such as Random Forest and Logistic Regression can be applied to student-related academic data to identify attendance risks and estimate performance trends. AI-based recommendation systems can also provide suggestions based on student progress and academic requirements.

Research Gap: Existing academic platforms commonly address attendance management, digital learning, assignment handling, or performance analysis as separate functionalities. There is a need for an integrated system that combines these academic processes with dynamic QR-based attendance verification, curriculum progress tracking, centralized learning resources, role-based management, and AI-powered academic assistance. The proposed Smart Curriculum, Academic Activity and Attendance Management System addresses this gap through a unified mobile application for students, faculty members, and HODs, supported by React Native, FastAPI, and Supabase.

III. METHODOLOGY

A. Proposed System Development Methodology

This paper adopts a system design and development methodology to develop the Smart Curriculum, Academic Activity and Attendance Management System. The proposed application integrates academic activities into a centralized mobile platform to improve communication, simplify academic administration, and support student progress monitoring.

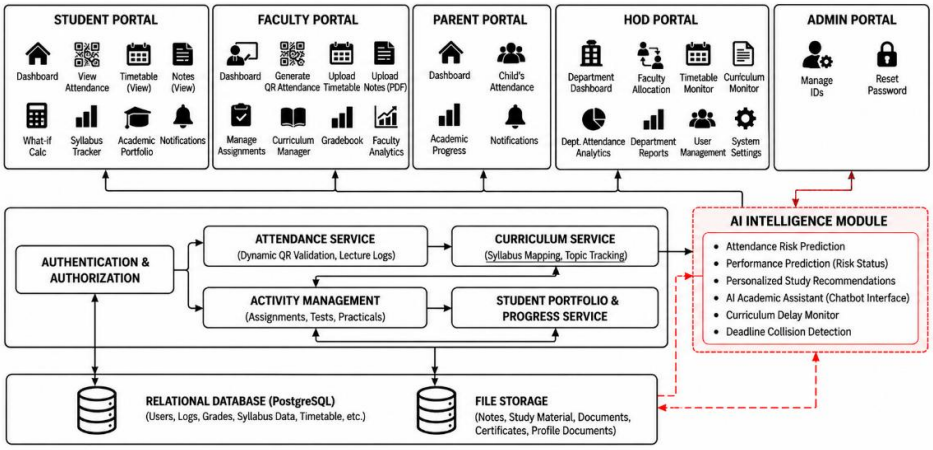


Fig. 1. Proposed development workflow of the Smart Curriculum, Academic Activity and Attendance Management System.

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B. Requirement Analysis and User Modules

1. **Student Module:** Students can view subject-wise attendance records, scan dynamic QR codes to mark attendance, calculate attendance requirements, track curriculum completion, access digital study materials, submit assignments, view marks and feedback, monitor practical activities, and receive academic notifications. An AI-powered academic assistant is also proposed to help students with academic queries.
2. **Faculty Module**: Faculty members can manage lectures, generate dynamic QR codes, monitor attendance, update curriculum progress, create assignments, evaluate submissions, upload notes and study materials, manage practical activities, and analyze student performance.
3. **HOD Module:** The HOD can monitor departmental activities, manage student and faculty information, allocate subjects and faculty responsibilities, track curriculum completion, analyze attendance statistics, monitor faculty workload, and generate departmental reports.
4. **AI Intelligence Module:** This module supports attendance-risk identification, academic performance prediction, curriculum progress analysis, personalized recommendations, and AI-assisted academic support.

C. Proposed System Architecture

- The proposed system follows a modular client-server architecture consisting of a mobile application, backend services, database services, and an AI/ML processing layer.
- The mobile application is developed using React Native and TypeScript, providing a common interface for Android-based mobile devices. Python FastAPI handles backend operations, including attendance validation, academic data processing, assignment management, and communication with machine learning models. Supabase PostgreSQL is used for structured data storage, while Supabase Authentication, Storage, and Realtime services support secure access, document management, and real-time updates.
- The AI/ML layer processes relevant academic information to generate predictions and recommendations. Communication between the application and backend is handled through REST APIs, while appropriate authentication and authorization mechanisms control access to role-specific resources.

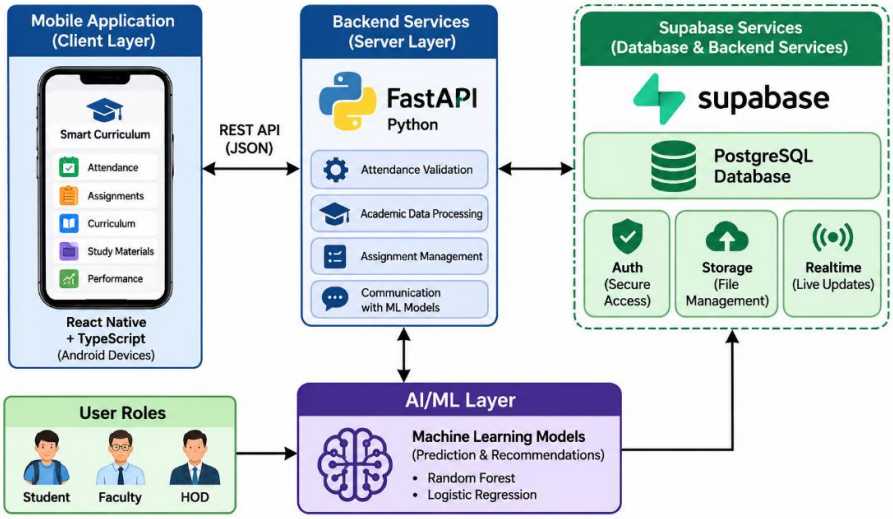


Fig. 2. Proposed architecture of the Smart Curriculum, Academic Activity and Attendance Management System.

D. Dynamic QR-Based Attendance Management

- The proposed attendance module uses dynamic, session-specific QR codes to record student attendance. Faculty members initiate a lecture session and generate a QR code containing session-related information. Students scan the displayed code through the mobile application, and the request is sent to the FastAPI

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backend for verification.

- The verification process uses HMAC-SHA256 to authenticate the QR session data and validate its integrity. The backend checks the session validity, associated subject, lecture details, and student eligibility before recording attendance. Session expiration and duplicate-submission checks can further reduce unauthorized or repeated attendance requests.
- The attendance percentage is calculated using the following mathematical expression:

$$A_p = \frac{L_a}{L_c} \times 100$$

Where:

- (A_p) represents the attendance percentage.
- (L_a) represents the number of lectures attended.
- (L_c) represents the total number of conducted lectures.
- The what-if attendance calculator helps students estimate the number of additional lectures required to achieve a target attendance percentage. If the target attendance is (T), the minimum number of additional lectures to attend without missing any further lectures can be calculated as:

$$N = \max\left(0, \left\lceil \frac{TL_c - 100L_a}{100 - T} \right\rceil\right)$$

This calculation assumes that every future lecture is attended and that the target percentage is less than 100%.

E. Curriculum and Academic Activity Tracking

- The curriculum tracking module monitors the progress of subjects and academic activities throughout the semester. Faculty members can update completed topics, while students can view the syllabus, completed units, pending topics, and overall curriculum progress.
- Curriculum completion can be represented as:

$$C_p = \frac{U_c}{U_t} \times 100$$

- Where (C_p) represents curriculum completion percentage, (U_c) represents completed units or topics, and (U_t) represents the total units or topics.
- The assignment management module allows faculty members to create assignments with descriptions, deadlines, attachments, and submission requirements. Students can submit their work, track submission status, and view marks and faculty feedback. The digital learning resource module provides centralized access to PDF files, presentations, documents, practical manuals, reference materials, previous question papers, videos, and external learning links.

F. Artificial Intelligence and Machine Learning Methodology

1. **Attendance Risk Prediction:** Random Forest and Logistic Regression algorithms are considered for classifying students according to attendance-related risk. Relevant input features may include attendance percentage, subject-wise attendance, previous attendance patterns, and remaining lectures. The output can identify students who may be at risk of falling below the required attendance threshold.
2. **Academic Performance Prediction:** Random Forest Regression can be used to estimate student performance based on available academic indicators such as previous marks, assignment performance, attendance, and test results. The predicted values can help identify areas where additional academic support may be beneficial.
3. **Curriculum Progress Analysis:** A progress-rate mechanism compares the planned curriculum schedule with actual topic completion. It can identify subjects that are progressing slower than the planned academic schedule and provide relevant notifications.

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G. Database Design and Data Management

- Supabase PostgreSQL is used as the primary relational database for storing application information. The database is organized into related entities such as users, student profiles, faculty profiles, departments, subjects, lecture sessions, attendance records, curriculum units, assignments, submissions, learning resources, marks, and notifications.
- Supabase Authentication manages user authentication, while Row Level Security (RLS) policies restrict access according to user roles and permissions. Supabase Storage supports the management of uploaded academic documents, assignment files, and learning resources. Realtime services can be used to deliver relevant updates to connected application users.
- FastAPI manages application-level business logic and validates requests before performing database operations. This separation of responsibilities supports modular development and improves the maintainability of the application.

H. System Evaluation Methodology

- **Functional Testing:** Verification of student, faculty, and HOD module operations.
- **Attendance Accuracy:** Validation of QR-based attendance recording and duplicate-submission prevention.
- **Machine Learning Evaluation:** Accuracy, precision, recall, F1-score, and suitable regression metrics such as MAE and RMSE.
- **Performance Testing:** Measurement of API response time, database query performance, and application responsiveness.
- **Security Testing:** Verification of authentication, role-based access, and database access restrictions.
- **Usability Testing:** Evaluation of navigation, accessibility, ease of use, and user feedback.

IV. RESULTS AND DISCUSSION

The proposed Smart Curriculum, Academic Activity and Attendance Management System integrates multiple academic processes into a unified mobile application. The system is designed to provide separate interfaces for students, faculty members, and Heads of Departments (HODs), enabling efficient management of academic activities. The expected outcomes are discussed based on the proposed system architecture, functional modules, and evaluation criteria. Quantitative performance results are not reported because experimental measurements have not yet been established.

Table I. Functional Comparison of the Proposed System Modules

Evaluation criterion	Student module	Faculty module	HOD module
Attendance management	View and track attendance	Generate QR and manage attendance	Monitor departmental attendance
Curriculum tracking	View completed and pending topics	Update curriculum progress	Monitor subject-wise completion
Assignment management	Submit assignments and view feedback	Create and evaluate assignments	Monitor assignment activities
Learning resources	Access and download study materials	Upload and manage resources	Monitor resource availability
Academic analytics	View personal progress	Analyze student performance	View departmental reports

A. Discussion of System Functionality

The proposed system combines academic functionalities that are commonly handled through separate platforms. Its integrated approach is expected to improve accessibility, reduce repetitive administrative work, and provide a centralized view of academic activities.

1. **Attendance Management:** Dynamic QR-based attendance provides a digital method for recording lecture attendance. Session-specific QR generation and HMAC-SHA256 verification are intended to improve

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attendance security. Students can view subject-wise attendance records and use the attendance calculator to estimate the lectures required to achieve a target percentage.

2. **Curriculum Tracking:** The curriculum management module provides visibility into completed and pending syllabus topics. Faculty members can update topic completion, while HODs can monitor subject-wise and departmental curriculum progress. This functionality is expected to help identify delays in syllabus completion.
3. **Assignment and Learning Resource Management:** The assignment module supports assignment creation, submission, evaluation, and feedback. The digital resource library provides access to academic documents, practical manuals, presentations, previous question papers, and other learning materials. Integrating these features can simplify academic communication and improve resource accessibility.
4. **Departmental Monitoring:** The HOD dashboard provides an overview of attendance statistics, curriculum completion, faculty workload, assignment activities, and student performance. Centralized reporting is expected to support departmental monitoring and academic decision-making.

B. Discussion of Artificial Intelligence and Machine Learning

- The AI/ML module is designed to support academic monitoring through predictive analysis and intelligent assistance.
- Random Forest and Logistic Regression algorithms can be used for attendance-risk classification by analyzing attendance percentages and related academic indicators. Random Forest Regression can estimate academic performance using available student records, including previous marks, assignment performance, and attendance information.
- The curriculum progress analysis mechanism compares planned syllabus completion with actual progress to identify possible delays. In addition, the AI-powered academic assistant is designed to provide contextual responses to student queries related to attendance, assignments, curriculum, and learning resources.

C. Qualitative Comparison with Traditional Academic Management

Table II. Comparison of Traditional and Proposed Academic Management Approaches

Evaluation criterion	Traditional approach	Proposed system
Attendance recording	Manual or separate digital tools	Dynamic QR-based attendance
Attendance monitoring	Periodic manual checking	Subject-wise tracking and alerts
Curriculum monitoring	Manual progress updates	Centralized curriculum tracking
Assignment handling	Separate submission channels	Integrated assignment workflow
Study materials	Multiple sharing platforms	Centralized digital resource library
Department monitoring	Separate records and reports	Centralized HOD dashboard
Student assistance	Faculty-dependent support	AI-powered academic assistant

D. System Evaluation and Performance Analysis

The proposed application can be evaluated using functional testing, performance testing, security testing, and machine learning evaluation. Attendance verification can be assessed by checking QR session validity, duplicate submissions, and correctness of stored records. API performance can be measured through response time and database query execution.

- Attendance verification accuracy and duplicate detection rate.
- API response time and database operation efficiency.
- Assignment submission and evaluation processing time.
- Machine learning classification and regression performance.
- Application usability and user satisfaction.
- Actual numerical values, benchmark comparisons, and experimental improvements should be included after implementation and testing.

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E. Limitations and Future Improvements

- Although the proposed system integrates multiple academic functionalities, its effectiveness depends on reliable internet connectivity for cloud-based operations, proper management of academic records, and secure authentication. Machine learning predictions require sufficient historical data to produce meaningful results. Similarly, AI-generated responses must be validated to reduce inaccurate or irrelevant academic information.
- Future improvements may include offline attendance record synchronization, enhanced predictive analytics, integration with institutional ERP systems, multilingual AI assistance, advanced academic recommendation mechanisms, and improved reporting dashboards. Additional security mechanisms and large-scale testing can further strengthen system reliability and usability.

V. CONCLUSION AND FUTURE WORK

The Smart Curriculum, Academic Activity and Attendance Management System provides an integrated approach to managing academic activities in higher education institutions. By combining QR-based attendance management, curriculum tracking, assignment submission, digital study materials, examination management and academic performance monitoring, the proposed system aims to simplify academic administration and improve student engagement. The integration of React Native, FastAPI and Supabase provides a centralized platform for managing academic information, while machine learning techniques support attendance-risk prediction and student performance analysis. Additionally, the AI-powered academic assistant offers personalized academic information and recommendations based on student records and learning resources.

Future work will focus on three major directions: (1) improving machine learning models through larger academic datasets and evaluating their prediction accuracy across different academic environments; (2) enhancing the AI-powered academic assistant with advanced document understanding, automated notes summarization and personalized learning recommendations; and (3) extending the system with advanced security mechanisms, multilingual support .

VI. DECLARATIONS

A. Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

B. Conflict of Interest

The author declares no conflict of interest.

C. Data Availability

The data supporting this review are derived from previously published research papers cited in the references. No new dataset was generated for this study.

D. Ethics Statement

This study did not involve human or animal subjects.

E. Author Contributions

R.S.N.: Conceptualization, Methodology, Investigation, Literature Review, Writing — original draft, and Writing — review and editing. The author has read and agreed to the published version of the manuscript.

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