Automated Academic Report Generation and Management System for Institutes

[1]Dr. Ravindra L. Pardhi, [2]Ms. Sanika Gadekar, [3]Ms. Ankita Deshmukh, [4]Mr. Yash Bakde, [5]Mr. Mayank Gaur, [6]Mr. Satvik Deshmukh,
[1,2,3,4,5,6] Department of Information Technology,
[1,2,3,4,5,6]Sipna College of Engineering and Technology, Amravati.
rlpardhi@sipnaengg.ac.in, sanikagadekar669@gmail.com, deshmukhankita911@gmail.com, bakdeyash@gmail.com, gaurmayank629@gmail.com, satvikdeshmukh23@gmail.com

***Abstract*— The proposed system, Sankalan – Institute Academic Portal, is designed to digitalise and simplify academic administration within educational institutions through a centralised web-based platform. The portal integrates major institutional functions such as student record management, attendance monitoring, marks entry, timetable handling, document storage, report generation, and role-based dashboard access for administrators, principals, department heads, and teachers. In addition to routine academic operations, the system incorporates an intelligent attendance risk prediction module that analyses student attendance patterns and identifies learners who may require early academic intervention. The platform is developed using a modern full-stack architecture to ensure secure access, real-time updates, efficient data handling, and scalable performance. Experimental implementation of the system demonstrates that it reduces manual workload, improves data accuracy, enhances communication among institutional roles, and supports faster academic decision-making. The framework offers a practical and extensible solution for institutions seeking efficient, transparent, and technology-driven academic management.**

Keywords— Academic Management System, Attendance Monitoring, Attendance Risk Prediction, Institute Portal, Role-Based Access Control, Student Performance Management.

1. INTRODUCTION

In recent years, educational institutions have increasingly adopted digital technologies to manage academic activities and administrative operations **[7], [11]**. Academic information such as student records, attendance, examination results, reports, and institutional documents is traditionally maintained through manual or semi-digital processes **[3], [5]**. These conventional approaches often lead to data redundancy, delayed information retrieval, increased paperwork, and difficulties in coordinating activities among different academic roles within the institution **[11], [12]**.

Traditional academic management methods rely heavily on manual record keeping, spreadsheets, and fragmented software tools **[5], [12]**. While these systems provide basic functionality, they often lack integration, real-time accessibility, and centralised control **[6], [7]**. As a result, administrators and faculty members face challenges in efficiently monitoring student performance, managing attendance records, generating institutional reports, and maintaining transparent communication between departments **[3], [4]**. Moreover, manual processing of academic data increases the possibility of errors and reduces overall operational efficiency **[11]**.

Recent advancements in web technologies and full-stack application frameworks have enabled the development of integrated academic management platforms that can automate institutional workflows, streamlining processes and enhancing efficiency **[6], [7], [9]**. Modern systems utilise secure authentication mechanisms, role-based access control, centralised databases, and real-time data synchronisation to streamline academic processes **[9], [10]**. These technologies allow institutions to efficiently manage large volumes of academic data while ensuring accessibility, reliability, and system scalability **[6], [7]**.

This research presents **Sankalan – an Institute Academic Portal**, a comprehensive web-based platform designed to support academic administration and institutional reporting **[8]**. The system integrates multiple functional modules, including student management, attendance tracking, mark management, timetable scheduling, document handling, and report generation within a unified environment **[3], [5], [8]**. In addition, the platform incorporates an intelligent attendance risk

prediction module that analyses student attendance patterns to identify individuals who may be at risk academically **[13]**.

The proposed system provides a structured and automated solution for institutional academic management by enabling centralised data storage, secure role-based access for administrators and faculty members, and analytical insights through data visualisation and predictive analysis **[10], [13]**. By combining modern web technologies with intelligent data analysis, the Sankalan portal improves operational efficiency, reduces administrative workload, and supports data-driven academic decision-making within educational institutions **[6], [7], [13]**.

2. RELATED WORK

The development of academic management systems has attracted significant research attention due to the growing need for efficient digital solutions in educational institutions. Many studies have explored web-based portals, enterprise academic systems, and intelligent data-driven platforms that aim to simplify institutional administration. These systems focus on managing student information, academic records, and administrative workflows through centralised digital platforms.

A. Web-Based Academic Management Systems

Several researchers have proposed web-based academic management platforms to replace traditional manual record-keeping methods used in institutions. These systems allow administrators and faculty members to manage student data, attendance records, course information, and academic reports through centralised web interfaces. Most of these platforms rely on relational database management systems and web frameworks to provide secure access, easy data retrieval, and automated reporting features. While such systems significantly reduce paperwork and improve data accessibility, many of them lack advanced analytical capabilities for monitoring academic performance or predicting student outcomes.

B. Enterprise Resource Planning (ERP) Systems in Education

Educational ERP systems have also been widely studied as comprehensive solutions for managing institutional resources and academic processes. ERP-based platforms integrate multiple institutional functions such as admissions, examination management, attendance monitoring, staff records, and report generation into a single unified system. These solutions improve coordination between departments and enhance transparency in administrative operations. However, ERP implementations are often complex, expensive to deploy, and difficult to customise for the specific academic needs of individual institutions.

C. Role-Based Academic Portals

Another important area of research focuses on role-based academic portals that provide customised dashboards for different users, such as administrators, teachers, department heads, and institutional authorities. These systems enable controlled access to academic data using role-based access control mechanisms. Teachers can manage attendance and marks, department heads can monitor departmental activities, and administrators can oversee institutional operations. Such role-based systems improve data security and allow institutions to maintain structured workflows, though many existing implementations still rely on basic database operations without advanced automation or predictive analysis.

D. Data Analytics for Academic Performance Monitoring

Recent studies have explored the use of data analytics and visualisation techniques to analyse academic data and monitor student performance. By analysing historical attendance records, examination results, and student engagement metrics, institutions can gain valuable insights into learning patterns and academic risks. Data visualisation tools and dashboards help administrators identify trends, track academic progress, and make informed decisions for academic improvement. However, many of these analytical systems are implemented as separate tools rather than integrated components of academic management platforms.

E. Predictive Analytics for Student Risk Identification

The use of machine learning techniques in education has opened new opportunities for predicting academic risks and identifying students who may require additional support. Algorithms such as decision trees, random forests, and regression models have been used to analyse student attendance, performance trends, and engagement data. These predictive systems can help institutions detect potential academic issues early and provide timely interventions. Despite their potential benefits, many predictive models are not fully integrated into institutional portals, limiting their practical usability in daily academic operations.

The review of existing systems highlights the need for an integrated platform that combines academic management, role-based access, real-time data handling, and predictive analytics within a single framework. The Sankalan - Institute Academic Portal addresses these limitations by providing a unified web-based system that manages institutional data while incorporating intelligent attendance risk prediction and analytical dashboards to support efficient academic decision-making.

3. METHODOLOGY

The proposed methodology develops a centralised academic management platform that automates institutional data handling, academic reporting, and student performance monitoring through an integrated full-stack architecture. The system is designed to digitalise academic workflows such as student record management, attendance tracking, marks management, timetable scheduling, document handling, and institutional reporting within a single platform. The architecture follows a modular design consisting of a frontend application, backend server, database layer, and AI-based attendance risk prediction service.

The workflow begins with secure user authentication and role validation, followed by controlled access to institutional modules based on the assigned role, such as Admin, Principal, Head of Department (HOD), and Teacher. Each module communicates with the backend services through RESTful APIs, which manage data processing and database interactions. The system also integrates a machine learning model that analyses attendance records to identify students who may be at academic risk.

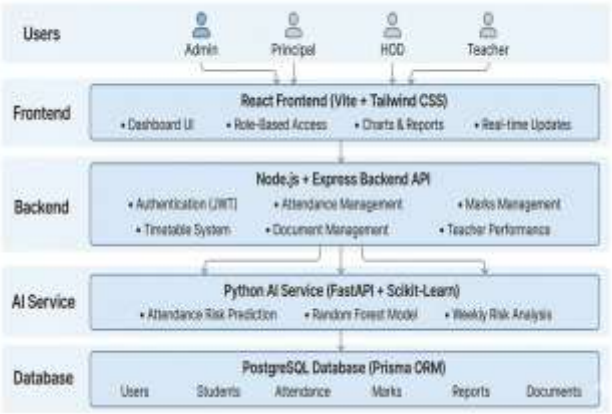


Fig. 1. System Architecture of Sankalan: Interaction flow between Frontend, Backend, Database, and AI Services.

The system evaluates academic performance and administrative efficiency through multiple functional modules. These modules collectively process institutional data and convert it into structured insights that support academic monitoring and decision-making. The methodology integrates authentication mechanisms, database-driven operations, and predictive analytics to create a scalable and efficient academic portal.

A. User Authentication and Role-Based Access Control

The first stage of the system focuses on secure user authentication and access management. Users such as administrators, teachers, HODs, and principals access the system through a login interface where credentials are validated against stored database records.

The authentication mechanism uses JSON Web Token (JWT) for session management and bcrypt hashing for secure password storage. Once authentication is successful, the server generates a JWT token containing user role information. This token is used to authorise access to specific modules within the system.

Role-Based Access Control (RBAC) ensures that users can only access features relevant to their responsibilities. For example, teachers can manage attendance and marks for their courses, HODs can monitor departmental performance, principals can oversee institution-wide reports, and administrators can manage system users and departments.

Fig. 2. Authentication and Role-Based Access Control Flow Diagram.

B. Student Information and Academic Data Management

The next component of the methodology focuses on student data management and academic record storage. The system maintains structured records including student profiles, enrolment details, departmental information, subject registrations, and academic history.

The backend server processes CRUD (Create, Read, Update, Delete) operations for student records through API endpoints. Data is stored in a PostgreSQL relational database using Prisma ORM, which provides schema management and query optimisation.

Each student record is linked with multiple academic entities such as attendance sessions, marks, subject enrolments, and extracurricular activities. This relational structure ensures that the system can efficiently track a student's academic journey across semesters and subjects.

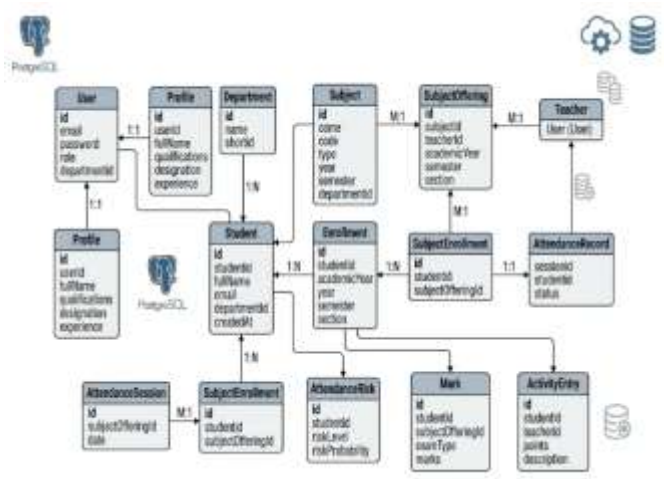
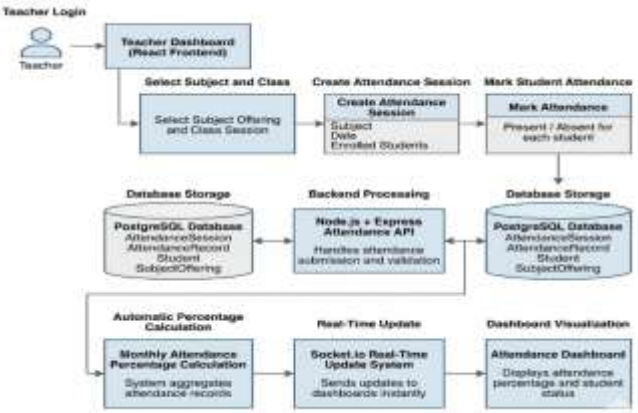


Fig. 3. Database Entity Relationship Diagram (ERD) for Sankalan Academic Portal.

C. Attendance Monitoring System

The attendance management module enables teachers to create attendance sessions and mark student presence or absence for specific subjects. When a class session is created, the system records attendance data for each enrolled student and stores it within the database.

The platform automatically calculates monthly



attendance percentages for every student using accumulated attendance records. These percentages are used for performance monitoring and early identification of students who may face attendance shortages.

The system also supports real-time updates using Socket.io, allowing dashboards to refresh automatically when attendance records are updated.

Fig. 4. Process Flow for Attendance Marking and Automated Percentage Generation.

D. AI-Based Attendance Risk Prediction

To enhance academic monitoring, the system integrates a machine learning based risk prediction module implemented using Python and FastAPI. The module analyses attendance patterns and predicts whether a student falls into one of three risk categories: SAFE, WARNING, or HIGH_RISK.

The model uses a Random Forest Classifier, trained on attendance-related features such as attendance percentage, number of absences, and lecture participation trends. When the dashboard requests risk analysis, the backend sends attendance data to the AI service, which processes the data and returns predicted risk levels.

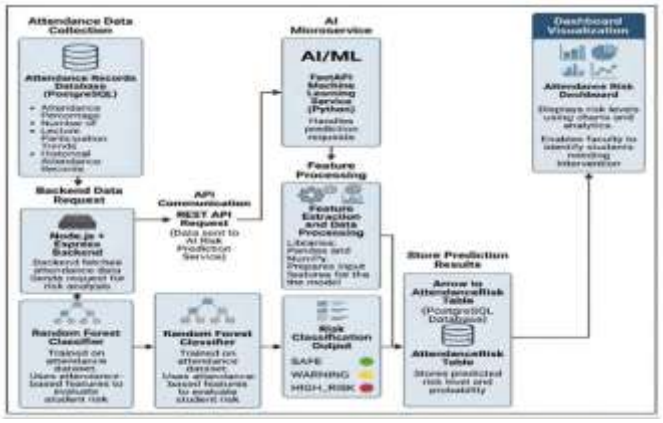


Fig. 5. Predictive Analysis Pipeline for Student Attendance Risk Assessment.

The results are stored in the database and visualised through dashboards, enabling faculty members to identify students who require academic intervention.

E. Academic Performance and Marks Management

The marks management module enables teachers to record examination results such as mid-term tests, internal assessments, and final examinations. Marks are stored subject-wise and student-wise, allowing detailed academic performance analysis.

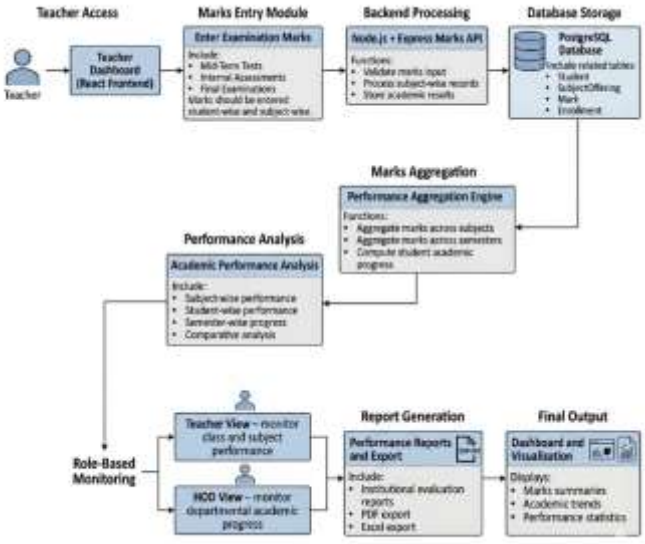


Fig. 6. Comprehensive Workflow for Academic Evaluation and Performance Analytics.

The system supports aggregation of marks across subjects and semesters, enabling teachers and department heads to monitor academic progress. Performance statistics can also be exported as reports for institutional evaluation.

F. Document and Report Management

The document management module allows faculty members to upload course materials, reports, and academic documents. Files are uploaded through the frontend interface and processed by the backend using Multer middleware, which handles multipart file uploads.

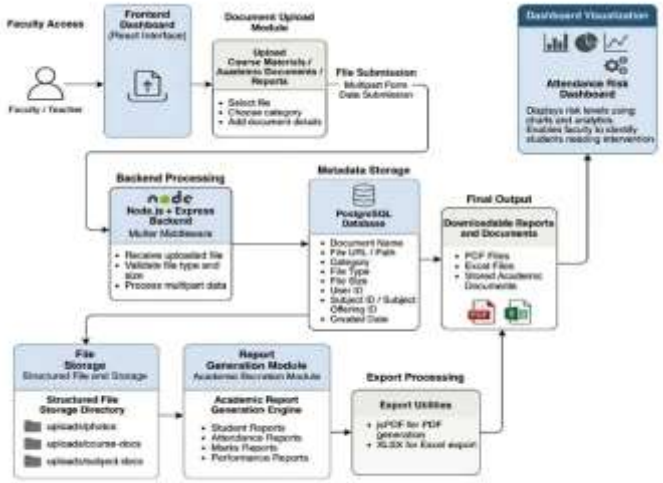


Fig. 7. Workflow for Document Management and Automated Academic Reporting.

Uploaded documents are stored in a structured file directory while their metadata is saved in the database. The system also enables automatic generation of academic reports, which can be exported in PDF or Excel format using libraries such as jsPDF and XLSX.

G. Dashboard Visualisation and Decision Support

The final stage of the methodology focuses on data visualisation and analytical dashboards. The system provides customised dashboards for each user role, displaying relevant institutional metrics such as student attendance trends, academic performance, teacher activity statistics, and risk prediction summaries.

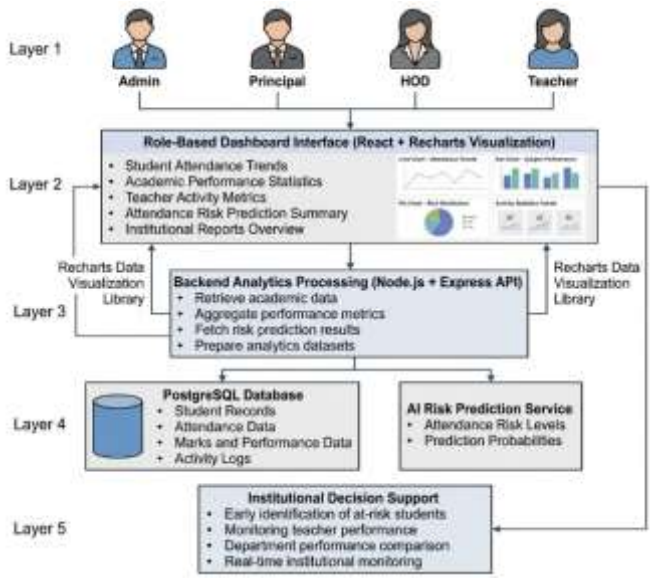


Fig. 8. Role Specific Dashboard for Academic Analytics and Oversight.

Charts and graphs are generated using visualisation libraries to help administrators and academic authorities interpret institutional data efficiently. These dashboards support informed decision-making and enable educational institutions to monitor academic operations in real time.

4. DATASET DESCRIPTION

The proposed Sankalan – Institute Academic Portal operates on structured institutional data collected from academic records within an educational institution. The dataset used in this system primarily consists of student information, attendance records, academic marks, departmental details, subject data, and teacher performance metrics. These datasets represent real-world academic operations and are stored in a relational database structure using PostgreSQL with Prisma ORM schema management.

The student dataset contains detailed information related to student identity and academic enrolment. Each record includes attributes such as student ID, full name, department, email, academic year, semester, and section. The dataset also stores relationships between students and their subject enrolments, attendance records, examination marks, and extracurricular activities. This structured data enables the system to monitor academic progress and generate performance reports.

Another major component of the dataset is the attendance dataset, which records daily attendance sessions conducted by teachers for different subject offerings. Each attendance entry includes the session date, subject information, student presence status, and calculated monthly attendance percentage. These attendance records form the primary input for the machine learning model used for attendance risk prediction.

The system also maintains datasets related to teacher performance, course offerings, academic reports, timetable scheduling, and institutional documents. Teacher datasets include attributes such as teaching assignments, feedback ratings, training participation, event organisation records, and administrative responsibilities. These datasets allow institutional authorities to evaluate faculty performance and departmental efficiency.

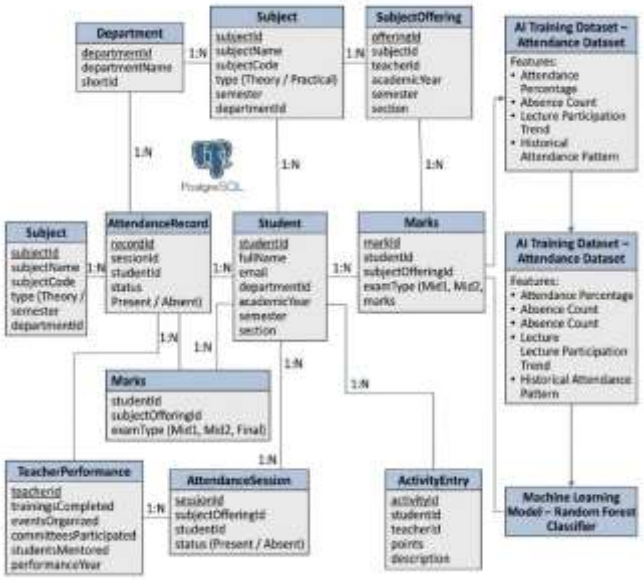


Fig. 9. Entity Relationship (ER) Model for the Sankalan Academic Repository.

To ensure efficient model training and accurate academic monitoring, the data used for predictive analysis is processed and structured using Python-based data preprocessing tools such as Pandas and NumPy. The attendance dataset used for machine learning training contains features such as attendance percentage, absence count, lecture participation trends, and historical attendance patterns.

The datasets are divided into multiple stages, including training, validation, and prediction phases. The training dataset is used to build the machine learning model that predicts attendance risk levels, while validation data helps optimise model performance and prevent overfitting. Once the model is trained, it is deployed through the AI service to evaluate real-time student attendance data and classify students into different risk categories.

A. Data Distribution and Academic Record Statistics

The institutional dataset shows variation across multiple academic entities, such as students, departments, subjects, and attendance sessions. Each department maintains its own student records and course offerings, which results in different data volumes across departments.

Student records typically include multiple relational entries because each student can enrol in several subjects and attend multiple class sessions throughout the semester. Similarly, attendance data is generated frequently because teachers record attendance for each lecture conducted. This results in a large volume of attendance records compared to other academic datasets.

Attendance percentage distribution plays a significant role in identifying academic risks. Students with high attendance percentages are categorised as safe, while those with frequent absences may fall into warning or high-risk categories. These patterns provide meaningful statistical insights that help in monitoring academic engagement.

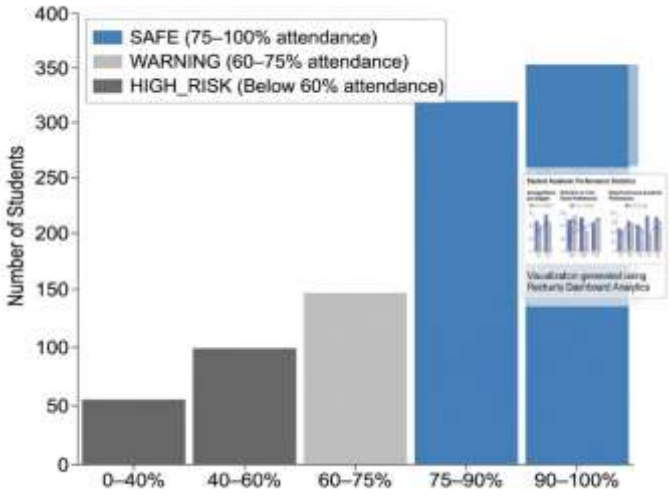


Fig. 10. Graphical Representation of Attendance Trends and Student Performance Statistics.

In addition to attendance statistics, the dataset also includes examination marks for multiple assessment types such as midterm tests and final examinations. The marks dataset allows the system to analyse academic performance trends across subjects and semesters.

B. Data Organisation and Storage Structure

The academic data used in the Sankalan system is organised in a relational database schema designed to maintain data integrity and support efficient querying. The database schema contains interconnected tables such as User, Student, Department, Subject, Subject Offering, Attendance Record, Marks, Document, and Report.

Each dataset is linked through foreign key relationships to ensure structured data flow between modules. For example, a student record is linked with attendance sessions, subject enrolments, and marks data. Similarly, teacher records are connected with subject offerings, timetable entries, and performance metrics.

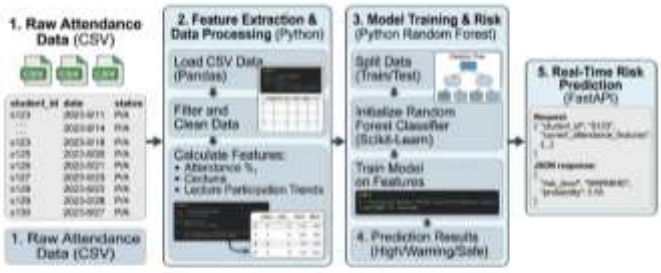


Fig. 11. Data Flow Architecture for the Attendance Risk Prediction Model.

The system maintains separate data storage mechanisms for different types of information. Structured academic data is stored in PostgreSQL tables, while uploaded documents such as course materials and reports are stored in dedicated file directories. Metadata related to these documents is maintained within the database to allow easy retrieval and management.

To support predictive analytics, the attendance dataset used for machine learning training is stored in CSV format within the AI service module. This dataset is processed using Python scripts that generate training data and build the risk prediction model using the Random Forest algorithm.

5. RESULTS AND DISCUSSION

A. System Performance Evaluation

The performance of the Sankalan – Institute Academic Portal was evaluated based on its ability to manage academic data efficiently, automate institutional workflows, and provide predictive insights for attendance monitoring. The evaluation focused on system responsiveness, accuracy of attendance risk prediction, database efficiency, and usability of role-based dashboards.

The portal successfully integrates multiple institutional modules such as student management, attendance tracking, marks entry, timetable scheduling, document

handling, and report generation within a single platform. The system processes academic operations through RESTful APIs, ensuring smooth communication between the frontend application, backend server, database, and AI prediction service.

One of the major components evaluated in the system is the AI-based attendance risk prediction module. The model analyses attendance data and classifies students into three categories: SAFE, WARNING, and HIGH_RISK. The prediction results are displayed on dashboards, allowing faculty members to monitor attendance trends and identify students who may require academic intervention.

Fig. 12. Visualisation of AI-Driven Student Risk Assessment and Attendance Analytics.

The system also demonstrates high reliability in managing institutional data because all academic records are stored within a relational database. Data retrieval operations such as fetching student records, attendance history, and marks reports are executed efficiently using optimised queries through Prisma ORM.

B. Module-wise Performance Analysis

The performance of individual system modules was analysed to understand how each component contributes to the overall functionality of the portal.

The authentication module successfully ensures secure access through JWT-based authentication and roles based authorization. Users are redirected to customised dashboards based on their assigned roles, preventing unauthorised access to sensitive academic data.

The student management module enables administrators and faculty members to perform CRUD operations on student records efficiently. Bulk data import functionality allows institutions to upload large numbers of student records through Excel or CSV files, significantly reducing manual data entry effort.

The attendance management module performs real-time attendance tracking and automatic calculation of attendance percentages. Teachers can mark attendance during each lecture session, and the system automatically updates attendance statistics for students.

The marks management module provides structured storage and retrieval of examination results. Teachers can enter marks for different assessments, such as midterm tests and final examinations, while department heads and principals can analyse performance trends across subjects and semesters.

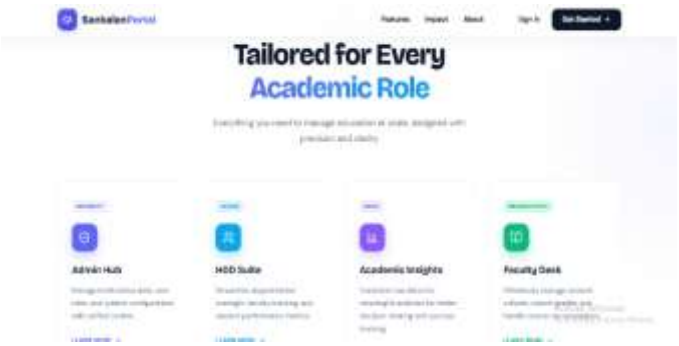


Fig. 13. Integrated Role-Based User Interface for Stakeholder Management.

The document management and report generation module allows academic staff to upload course materials and generate institutional reports. Reports can be exported in PDF and Excel formats, enabling easy sharing and documentation of academic information.

C. Predictive Analysis and Academic Insights

The integration of machine learning significantly enhances the system's ability to provide analytical insights. The Random Forest-based prediction model analyses historical attendance records to detect patterns that indicate potential academic risks.

When the system processes attendance data, the AI service calculates risk probability values and classifies students accordingly. Faculty members can use these predictions to identify students with low attendance and take corrective measures such as counselling or academic monitoring.

Fig. 14. Comparative Visualisation of Attendance Trends.

The predictive dashboard visually represents attendance trends among students. These visualisations help institutional authorities understand overall academic engagement levels and identify departments or classes where attendance issues may occur.

D. Qualitative Results and System Usability

The qualitative evaluation of the Sankalan portal demonstrates that the system improves institutional efficiency by automating several academic processes. The user-friendly interface and structured dashboards allow different stakeholders to access academic data quickly and effectively.

Teachers can easily manage course-related information such as attendance records, student lists, and mark entry. Department heads can monitor teacher performance and departmental statistics, while principals gain an institution-wide overview of academic activities.

The system's real-time features, implemented through Socket.io, allow dashboards to update automatically when academic records change. This ensures that administrators and faculty members always have access to the latest academic information.

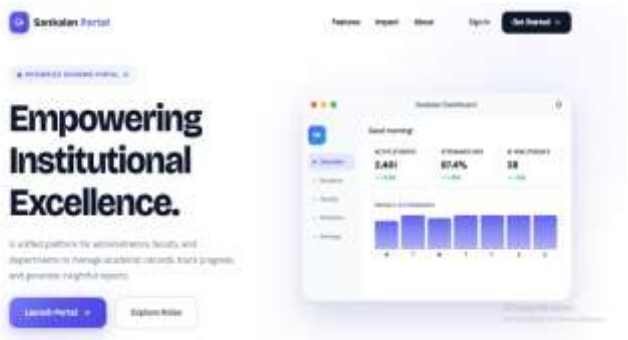


Fig. 15. Integrated Academic Management Interface of the Sankalan System.

Additionally, the integration of predictive analytics and visualisation tools improves decision-making by providing clear insights into academic trends. By combining automated data management with analytical dashboards, the Sankalan portal supports a data-driven approach to institutional academic management.

6. CONCLUSION

This study presents Sankalan – an Institute Academic Portal, a web-based system developed to improve the efficiency and organisation of academic management in educational institutions. The system integrates essential academic functions such as student record management, attendance monitoring, marks management, timetable scheduling, document handling, and report generation within a centralised digital platform. By replacing traditional manual processes with an automated solution, the portal helps reduce administrative workload, improve the accuracy of academic data, and enhance accessibility of institutional information. The system is built using a full-stack architecture and incorporates role-based access control to provide secure and customised dashboards for administrators, principals, HODs, and teachers. Additionally, the integration of a machine learning-based attendance risk prediction module enables the early identification of students who may require academic support by analysing attendance patterns. The implementation of the Sankalan portal demonstrates its effectiveness in streamlining academic operations, improving transparency, and supporting data-driven decision-making within educational institutions. Furthermore, the system provides a scalable framework that can be expanded with advanced analytics, mobile access, and intelligent monitoring features to further strengthen digital academic management in the future. Moreover, the system encourages better coordination among different stakeholders by providing real-time access to academic data and reports. It also promotes consistency in report generation through standardised formats across departments. Overall, Sankalan serves as a reliable and efficient solution for modernising institutional academic management systems.

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