

AI - BASED SMARTCLASS & TIMETABLE SHEDUDER

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Abstract: The AI-Based Smart Classroom & Timetable Scheduler is an intelligent, web-based platform designed to modernize and automate academic scheduling and classroom management in educational institutions. It replaces manual timetable creation and fragmented smart tools with an integrated AI-driven workflow that generates conflict-free schedules, dynamically adapts to changes, and synchronizes with IoT-enabled classrooms. Administrators, faculty, and students can securely access personalized dashboards to manage timetables, view attendance, and monitor classroom utilisation in real time. Smart modules for automated attendance, device control, and engagement tracking feed data into advanced analytics, ensuring transparency and informed decision-making at every level. The system supports interoperability with existing campus systems, enabling scalable deployment, continuous optimisation of schedules, and reliable, data-driven academic operations.

Keywords: Smart Classroom, Timetable Scheduler, AI-Based Scheduling, Classroom Automation, Web Application, Educational Workflow, Deep Learning, IoT Integration, Real-Time Analytics, Role-Based Dashboards, Institutional Resource Optimisation, Data-Driven Education.

I. INTRODUCTION

Manual, error-prone scheduling and fragmented classroom management are persistent challenges in many educational institutions, especially when administrators must coordinate large volumes of classes, teachers, and rooms using spreadsheets or paper-based methods. Traditionally, the lack of a unified digital workflow leads to timetable clashes, last-minute room or faculty changes, miscommunication between departments, and inefficient use of classrooms and faculty time. This disjointed process increases administrative workload, confuses students when updates are not communicated promptly, and prevents institutions from using data to improve planning and learning environments.

The AI-Based Smart Classroom & Timetable Scheduler is proposed to address these inefficiencies by providing a centralized, web-based platform that seamlessly connects administrators, faculty, and students. The system automates the entire academic scheduling workflow—from collecting teacher, course, and room data to generating AI-driven conflict-free timetables, publishing them online, and synchronizing them with IoT-enabled smart classrooms. Administrators can configure constraints and approve schedules, teachers can view and manage their classes and attendance, and students receive up-to-date timetables and notifications through dedicated dashboards that track each class or room in real time. Each timetable entry and classroom session is associated with clear metadata (course, teacher, room, status), ensuring transparency and accountability across the institution. Built-in alerts, change logs, and analytics-based feedback loops enable continuous communication and improvement, transforming a previously manual, error-prone process into an intelligent, data-driven academic management solution.

II. LITERATURE SURVEY

The growing need for automation in academic scheduling and classroom management has led to numerous advances in AI-based smart classroom and timetable systems. This section reviews recent research and innovations that have shaped the evolution of automated timetable generation and intelligent learning environments using artificial intelligence and IoT.

Dimitriadou et al. discussed the role of AI and emerging technologies in smart classrooms, highlighting how sensors, automation, and analytics can enhance engagement and classroom management but noting that many solutions still operate independently of institutional timetabling systems. In parallel, several works on AI-powered timetable generators, such as those by authors in JETIR and IJCR, demonstrate how machine learning and optimization techniques can produce conflict-free schedules more efficiently than manual methods, yet they often lack deep integration with smart classroom hardware or real-time usage data. These studies collectively motivate the need for a unified platform that combines AI-based timetable optimization with IoT-enabled smart classroom automation, which is the focus of the present project.

Patil et al. (2022) discussed an AI and IoT-based smart classroom framework that uses sensors, automation modules, and AI logic to enhance interaction and monitoring within the classroom environment. Their system focuses on features such as automatic attendance tracking, environmental control, and multimedia support, showing that smart technologies can significantly improve teaching-learning efficiency; however, it does not integrate with institutional timetable generation or scheduling optimisation.

Sharma et al. (2025) proposed an AI-powered automatic timetable generator that leverages artificial intelligence and genetic algorithms to produce conflict-free academic schedules while considering constraints like room availability, lecturer assignments, and course clashes. The authors demonstrated that their solution greatly reduces manual effort and can adapt to real-world institutional settings, but the work is limited to scheduling and does not connect the generated timetables with IoT-enabled smart classrooms or real-time usage analytics.

Arunmozhi et al. (2025) proposed an IoT-based smart classroom system that automates attendance, door access, and control of lights and fans using microcontrollers and sensors to create a safer, more efficient learning environment. Their work shows how IoT can modernize classroom operations and improve comfort, but it does not connect these automated classrooms with an AI-driven timetable or institution-wide scheduling logic.

Duche et al. (2026) developed a Smart Classroom System Using IoT that employs Raspberry Pi, cameras, and cloud connectivity to implement automatic attendance, environmental monitoring, and remote access to classroom data. The system demonstrates the practical feasibility of sensor-based monitoring and smart control in real classrooms; however, it treats the timetable as an external input and does not integrate AI-based timetable generation or analytics-driven resource optimisation, leaving space for more unified solutions like the present project.

More recent literature on smart classrooms and educational AI systems emphasizes interpretable analytics, security, and full end-to-end platform design rather than isolated tools. Studies on AI-powered classroom management and timetable solutions highlight the importance of role-based dashboards, audit-ready logging, and secure data pipelines that turn raw usage and performance data into actionable guidance for teachers and administrators. There is a growing focus on integrating learning analytics dashboards, privacy-preserving data handling, and compliance-friendly architectures so that AI-driven scheduling, attendance, and engagement insights can be safely deployed at scale, making automation truly practical and impactful for institutions, faculty, and students alike.

III. PROPOSED SYSTEM

The proposed AI-Based Smart Classroom & Timetable Scheduler is designed to transform academic management workflows by leveraging state-of-the-art artificial intelligence, web technologies, and IoT integration. At its core, the system employs optimization and machine learning techniques to automatically generate conflict-free timetables based on large, structured datasets containing faculty availability, classroom capacities, course requirements, and institutional constraints. The workflow begins with data acquisition through web-based forms, where administrators input teacher, room, and subject details that are validated and stored in a centralized database. These inputs are then processed by the scheduling engine, which iteratively refines timetable solutions to minimize clashes, balance workloads, and maximize classroom utilisation, producing optimized schedules in seconds rather than days. Once generated, timetables are published to an intuitive web interface that allows users to view schedules by faculty, class, or room, and any subsequent changes—such as faculty absence or room maintenance—trigger rapid recomputation and update of the schedule in near real time.

In parallel, the proposed system tightly integrates a smart classroom layer that uses IoT devices and analytics to link the timetable with real classroom activity. When a scheduled session starts, the system can automatically initiate attendance via cameras or RFID, control devices like lights and projectors, and log room usage data against the active timetable entry. All sensor readings and interaction logs are fed into an analytics module that extracts patterns related to attendance, room utilisation, and teaching load, which are then visualised through dashboards for administrators and faculty. The modular, web-based architecture supports secure role-based access, making it adaptable for different departments and scalable to multi-campus deployments. By automating scheduling, integrating smart classroom functions, and providing continuous feedback through advanced reports, the proposed system significantly reduces administrative workload, improves resource utilisation, and creates a transparent, data-driven academic environment.

The proposed solution is an advanced, AI-driven smart classroom and timetable management system designed to automate academic scheduling and streamline classroom operations. It uses intelligent optimisation algorithms, secure central data storage, and a unified web interface to generate clash-free timetables based on faculty availability, room capacity, and subject requirements, while instantly adapting to last-minute changes such as teacher absences or room reallocations. The platform is organised into modular components for data collection, constraint processing, timetable generation, smart classroom control (attendance, lights, projectors), and real-time visualisation of schedules and key metrics, all protected by robust role-based access and logging. Continuous monitoring and feedback from users and historical data allow the system to refine future schedules and resource allocation, making it highly scalable and adaptable for different departments and multi-campus institutions.

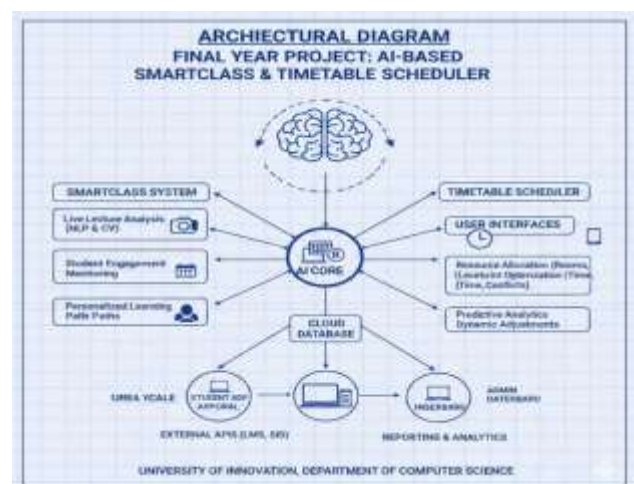
IV. PROPOSED SOLUTION

The proposed solution for this project is a comprehensive, artificial intelligence-based smart classroom and timetable management system that automatically generates and manages class schedules while coordinating classroom activities through a web platform. Central to this solution is an AI-powered scheduling engine that applies optimisation and machine learning techniques to handle complex constraints such as faculty availability, room capacity, subject combinations, and institutional rules, producing conflict-free timetables that would be difficult to achieve manually. The workflow begins with collecting and validating input data (teachers, rooms, subjects, time slots) through the web interface; these structured inputs are normalised and stored in a central database before being passed to the scheduling engine. The engine iteratively searches for the best timetable configuration, ensuring no overlaps and balanced workloads, and then publishes the final schedule back to the web portal, where it is instantly visible to administrators, staff, and students in an organised, user-friendly format.

In parallel, the system extends this timetable into the physical classroom through an integrated smart classroom layer. According to the generated schedule, IoT-enabled devices such as cameras, RFID readers, and smart switches can be triggered at the start of each session to record attendance, control lights and projectors, and log room utilisation against the corresponding timetable entry. All these interactions are captured and linked to the schedule, allowing the platform to compute statistics like attendance rates, classroom occupancy, and faculty teaching load, which are then presented as dashboards and reports for decision-makers. In this way, the proposed solution not only outputs an “academic timetable” but also provides a continuous feedback loop between scheduled plans and real classroom activity, enabling validation, optimisation, and more intelligent management of institutional resources over time.

This figure illustrates the complete architecture of the AI-Based Smart Classroom & Timetable Scheduler, showing how institutional data flows from initial input to actionable insights for administrators and faculty. The process begins with collecting teacher, course, room, and student details through the web portal or existing academic systems, which are securely stored in a central database. Within this data layer, validation, normalisation, and constraint mapping (availability, capacities, preferences) are performed to ensure high-quality input for scheduling. The AI timetable engine then uses this curated data to generate and manage optimised schedules, which are stored, versioned, and deployed to user dashboards. Simultaneously, smart classroom and analytics modules consume these schedules and live classroom data to produce real-time views, reports, and alerts that support informed decision-making.

MODULES



V. IMPLEMENTATION

The implementation of the AI-Based Smart Classroom & Timetable Scheduler transforms its conceptual architecture into a robust web-based platform that delivers AI-powered scheduling and classroom management for educational institutions. The system adopts a modular, scalable architecture to ensure maintainability, high performance, and secure handling of academic data. The frontend is developed using React.js (or a similar framework) for responsive dashboards, while a Python Flask/Django or Node.js backend exposes RESTful APIs that connect the web interface with the scheduling engine and database. The backend communicates with an AI/optimization module that generates conflict-free timetables and with a relational database (such as MySQL/PostgreSQL) that stores teacher profiles, room details, subject mappings, schedules, attendance records, and system logs. React's component-driven design supports intuitive workflows for viewing timetables, raising change requests, and monitoring smart classroom status, with real-time updates handled through asynchronous API calls and state management.

Each module in the platform is designed around specific academic use cases such as timetable creation, class rescheduling, smart classroom control, analytics viewing, and administrative oversight. Role-based dashboards ensure that every user—Administrator, Faculty, Student, and optionally Lab/Support Staff—sees only the tools and data relevant to their responsibilities. Administrators can configure constraints, generate and approve timetables, manage rooms and devices, and review utilisation reports; faculty can view their teaching schedule, mark or verify attendance, and monitor classroom conditions; students can access personalised timetables, attendance summaries, and notifications about changes; support staff can track room allocations and maintenance slots. Real-time status changes (for example, a class being moved or a faculty swap) are propagated to all dashboards via asynchronous API calls, so every user receives the latest information without page reloads. Security and privacy are enforced through JWT-based authentication, encrypted HTTPS communication, and strict role-based access control, while an Audit Logging module records key actions such as timetable changes, login events, and device operations, supporting transparency, compliance, and continuous improvement of the system.

1. LOGIN MODULE

This image shows the main dashboard of the CSE Timetable Management System. It provides a quick overview with summary cards displaying total staff, total subjects, and number of CSE sections. Below, the “Time Schedule Information” panel outlines working hours, including start/end times, break, lunch, and half-day details for Saturday. Special slots like Unit Tests and Lab Sessions are highlighted for easy reference. The left sidebar contains navigation options such as Dashboard, Timetable, Teacher Schedule, Sections, Staff, and Subjects.

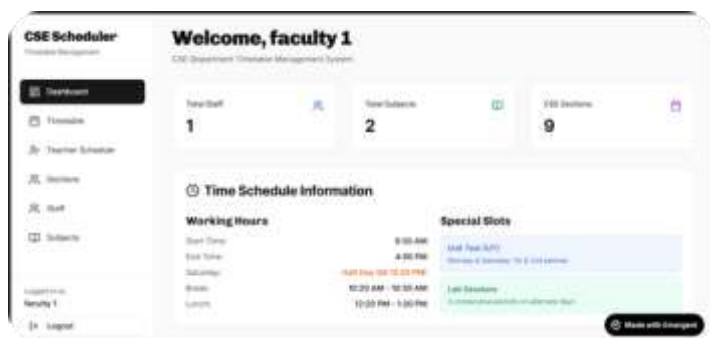


Fig 1.2 Login

2. TIMETABLE MANAGEMENT MODULE

This screen displays the timetable grid for a selected class (e.g., 3rd Year – Section A). It organizes subjects across days of the week and time slots, making it easy to visualize the schedule. Each cell shows subject codes, faculty initials, and additional labels like “Enhanced Features.” There is a “Generate” button to automatically create schedules and options to edit entries. Break periods are clearly marked, improving readability and usability.



Fig 1.2 Timetable Dashboard

3. EDIT TIMETABLE SLOT MODULE

This image shows a popup modal used to edit a specific timetable slot. Users can update the assigned subject and staff member using dropdown menus. It allows precise control over scheduling changes without modifying the entire timetable. The interface includes “Save Changes” and “Cancel” options for user actions. This feature ensures flexibility and quick updates in case of scheduling conflicts.



Fig 1.3 Edit Timetable

4. This section displays the weekly schedule for a selected teacher. It shows which class, subject, and section the teacher is assigned to for each period and day. Free periods are clearly indicated, helping identify available time slots. The layout supports viewing and swapping classes across sections for better resource management. A dropdown at the top allows selecting different teachers.



Fig 1.4 Teacher Schedule

5. Section Management Module

This image represents the section management module, where sections are grouped by academic year (e.g., 2nd Year, 3rd Year). It lists section names along with their respective years and provides actions like deletion. There is also an option to add new sections using the “Add Section” button. This module helps organize and manage multiple class sections efficiently within the system.

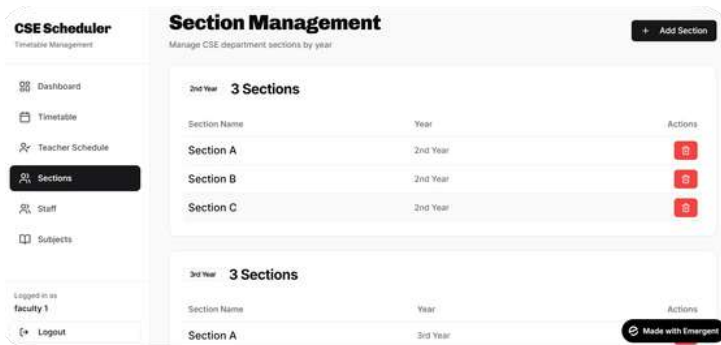


Fig 1.5 Section Management

6. Subject management module

The Subject Management module in the timetable system is responsible for handling all academic subjects offered within the department. It allows administrators to add, edit, and delete subjects along with details like subject code, name, and type (theory or lab). This module ensures that each subject is properly mapped to relevant sections and faculty members. It plays a critical role in timetable generation by providing structured subject data. Overall, it helps maintain consistency and accuracy in scheduling and academic planning.



Fig 1.6. Subject Management

VI. CONCLUSION

The conclusion of this project is that an AI-Based Smart Classroom & Timetable Scheduler can significantly improve how educational institutions plan and manage their academic activities. By automatically generating conflict-free timetables, adapting quickly to last-minute changes, and linking schedules with smart classroom functions like attendance and device control, the system reduces manual effort, minimises errors, and uses classrooms and faculty time more efficiently. The web-based dashboards and analytics convert raw data on utilisation and attendance into clear insights, helping administrators and teachers make better decisions and giving students timely, accurate timetable information. Overall, the project shows that combining AI scheduling, IoT-enabled classrooms, and secure web interfaces creates a practical, scalable solution that modernises academic management and supports a more organised, data-driven learning environment.

VII. REFERENCES

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