

Dynamic College Timetable Generator with Auto-Adjustment

Satyajeet S. Chougale

Rohan S. Nikam

Dinesh R. Rathod

Prajwal V. Patole

Department of CSE (Data Science)

D. Y. Patil College of Engineering & Technology

Kolhapur, Maharashtra, India

Project Mentor

Mrs. M. M. Wakarekar

Assistant Professor

Department of CSE (Data Science)

D. Y. Patil College of Engineering & Technology

Kolhapur, Maharashtra, India

Abstract—The college time table is often difficult to handle manually because of the need to balance multiple constraints like faculty availability, classroom allocation, laboratory scheduling and subject distribution. Preparing timetables is still a manual process in many institutions, which results in a higher probability of scheduling conflicts and consumes a significant amount of administrative time.

The work proposed here is a Dynamic College Timetable Generator with Auto-Adjustment. This is an automatic timetable generating system and deals with real time changes effectively. The system uses constraint-based scheduling techniques and optimisation logic to create conflict-free schedules. Unlike traditional static timetable systems, the proposed model allows for automatic rescheduling in the event of any kind of disturbance, such as faculty leave, unavailability of classrooms or any sudden academic event.

The system aims to minimise the disturbance in the timetable by modifying only the affected lectures instead of the whole schedule. Additional features like role-based dashboards, instant notifications, timetable export and future mobile compatibility improve usability and accessibility for students, faculty members and administrators.

The main aims of the project and works to reduce workload, improve scheduling accuracy and provide a more flexible academic management solution for colleges, school and universities.

Index Terms—Timetable Scheduling, Constraint Satisfaction, Automation, Academic Management, Dynamic Scheduling, OR-Tools

I. INTRODUCTION

Colleges and universities depend heavily on well-planned timetables for managing daily academic activities smoothly. Scheduling lectures, laboratories, classrooms, faculty members, and student batches in an organized manner is important for maintaining discipline and avoiding confusion within the institution. However, preparing timetables manually is often difficult and time-consuming because many academic constraints need to be handled together at the same time.

In many institutions, timetable preparation is still carried out manually or through basic static systems. While these methods may work for smaller schedules, they become difficult to manage when unexpected situations occur. Problems such as faculty leave, classroom unavailability, examination schedule changes, or academic events usually require administrators to

rearrange lectures manually. As a result, timetable clashes, uneven faculty workload distribution, and communication issues among students and teachers may occur frequently.

To address these challenges, this project introduces a Dynamic College Timetable Generator with Auto-Adjustment. The system is designed to automatically generate optimized and conflict-free timetables by considering factors such as faculty availability, classroom allocation, subject requirements, and laboratory sessions. A major advantage of the developed system is its ability to handle real-time timetable modifications with minimum disturbance instead of rebuilding the complete schedule again.

During the development process, managing overlapping laboratory sessions and balancing faculty schedules were some of the practical challenges observed. The project mainly focuses on reducing manual effort, improving scheduling flexibility, and making timetable management easier and more efficient for educational institutions.

II. LITERATURE SURVEY

Timetable scheduling has been an important part of academic management systems for many years because every educational institution needs a proper way to organize lectures, laboratories, classrooms, faculty members, and student batches without creating conflicts. Since timetable generation involves handling multiple constraints together, researchers have proposed different scheduling and optimization techniques to make the process more efficient and less dependent on manual work.

Earlier timetable preparation methods were mostly handled manually by administrators. While manual scheduling may work for smaller institutions, it becomes difficult to manage in colleges where multiple departments, classrooms, laboratories, and faculty schedules need to be considered together. Such methods also increase the chances of lecture clashes, improper classroom allocation, and imbalance in faculty workload distribution.

To improve timetable generation, several researchers introduced optimization techniques such as Genetic Algorithms (GA). In this method, timetable scheduling is treated as an

optimization problem where different timetable combinations are generated and improved step by step until a better schedule is obtained. Genetic Algorithms can produce effective schedules, but their performance may slow down when the amount of scheduling data becomes very large or more complex.

Constraint Satisfaction Problem (CSP) techniques are also commonly used in modern timetable systems. Tools like Google OR-Tools help handle scheduling constraints more efficiently by applying constraint programming methods. These systems consider hard constraints such as faculty availability, classroom allocation, and overlapping lecture prevention, along with soft constraints like preferred lecture timings and balanced faculty workload. Although CSP-based methods provide accurate scheduling results, they may require higher computational resources for larger datasets.

Researchers have additionally explored heuristic and local search approaches such as greedy algorithms, hill climbing, and simulated annealing because of their faster execution speed. These methods are suitable for practical scheduling applications where quicker timetable generation is required. However, they may not always guarantee the most optimized solution under every condition.

Many university ERP systems today also include timetable management modules, but most of them still follow static scheduling approaches. When unexpected situations occur, such as faculty leave, classroom maintenance, or timetable changes due to events, administrators often need to manually rearrange lectures or regenerate schedules again. This process can create inconvenience for students, teachers, and management staff.

From the analysis of existing systems and research papers, it was observed that many solutions mainly focus on timetable generation while giving less attention to real-time timetable adjustment and intelligent rescheduling. The proposed Dynamic College Timetable Generator with Auto-Adjustment attempts to address these limitations by supporting automatic rescheduling, minimal timetable disturbance, real-time notifications, and improved resource management for educational institutions.

III. PROBLEM STATEMENT

In many colleges, timetable preparation is still performed manually or using static scheduling systems. Managing subjects, faculty availability, classrooms, laboratories, and student batches together is a complex and time-consuming task. Manual scheduling often leads to lecture clashes, uneven workload distribution, and inefficient use of resources.

The major challenge arises when unexpected situations occur, such as faculty leave, classroom unavailability, examination changes, or academic events. In such cases, administrators must manually modify the timetable, which increases confusion and may affect multiple schedules simultaneously. Existing systems also lack proper real-time adjustment and communication mechanisms.

To overcome these issues, there is a need for an intelligent and automated timetable management system that can gener-

ate optimized, conflict-free schedules and dynamically adjust them whenever disruptions occur. The proposed Dynamic College Timetable Generator with Auto-Adjustment aims to reduce manual effort, improve scheduling efficiency, minimize conflicts, and provide instant timetable updates for students, faculty members, and administrators.

The problem addressed in this research is:

"To design and develop a Dynamic College Timetable Generator capable of automatically generating conflict-free schedules and intelligently adjusting them during real-time disruptions."

IV. OBJECTIVES

The objectives of the proposed system are as follows:

- To automate the timetable generation process with minimum manual effort.
- To create conflict-free schedules by considering faculty availability, classroom allocation, and subject requirements.
- To implement dynamic auto-adjustment during real-time timetable disruptions.
- To reduce scheduling conflicts and improve resource utilization.
- To provide role-based dashboards for administrators, faculty members, and students.
- To send instant notifications whenever timetable changes occur.
- To support timetable export in PDF and calendar formats.

V. PROPOSED SYSTEM

The proposed system consists of several interconnected modules for timetable creation, validation, rescheduling and communication.

The administrator inputs data like faculty information, classroom details, subjects, and lecture constraints. This data is then fed into the scheduling engine which uses constraint-based algorithms to create an optimised timetable.

In case of a disruption, the auto-adjustment module detects the affected sessions and smartly re-allocates them without disturbing the whole timetable. Then, users receive notifications about revised schedules.

A. System Modules

- 1) User Authentication Module
- 2) Faculty and Subject Management
- 3) Constraint Processing Engine
- 4) Scheduling and Timetable Generator
- 5) Dynamic Auto-Adjustment Engine
- 6) Notification System
- 7) Timetable Export Module

VI. METHODOLOGY

The system we propose is based on a constraint based scheduling approach. Hard constraints such as faculty availability, classroom capacity and overlapping prevention are strictly satisfied. Soft constraints, such as preferred time of

lectures and balanced load distribution, are optimised whenever possible.

The scheduling process involves the following stages:

- 1) Data Collection
- 2) Constraint Validation
- 3) Initial Timetable Generation
- 4) Conflict Detection
- 5) Auto-Adjustment and Rescheduling
- 6) Notification and Timetable Update

Google OR-Tools and heuristic scheduling methods are considered for timetable optimization and conflict resolution.

VII. EXPERIMENTAL SETUP

The system was tested using a sample college dataset containing faculty information, subjects, laboratories, classrooms, and student batches.

A. Software Requirements

- Frontend: React.js with Tailwind CSS
- Backend: Node.js / FastAPI
- Database: PostgreSQL
- Optimization Library: Google OR-Tools
- Deployment: Docker and Cloud Platforms

B. Hardware Requirements

- Intel i5/i7 Processor
- 8 GB RAM or higher
- SSD Storage

VIII. EXPECTED RESULTS

The proposed system is expected to generate optimized and conflict-free timetables while significantly reducing manual effort. The auto-adjustment mechanism should efficiently handle sudden scheduling changes within a few seconds.

The project also aims to improve communication transparency between faculty members, students, and administrators by providing instant timetable updates.

IX. SYSTEM IMPLEMENTATION AND RESULTS

The proposed Dynamic College Timetable Generator was developed using modern web technologies to provide an efficient and user-friendly timetable management system. The following screenshots represent different modules of the implemented system.

A. Admin Dashboard

The admin dashboard allows administrators to manage timetables, monitor lecture activities, and handle scheduling operations efficiently.

B. Faculty Dashboard

The faculty dashboard provides teachers with timetable access, lecture details, and scheduling information.

C. Faculty Login Panel

The faculty login module provides secure authentication for faculty members before accessing the system.

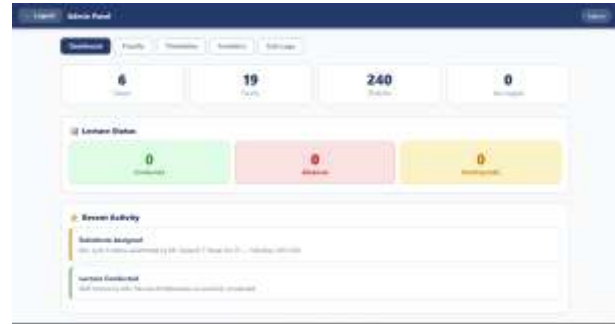


Fig. 1. Admin Dashboard

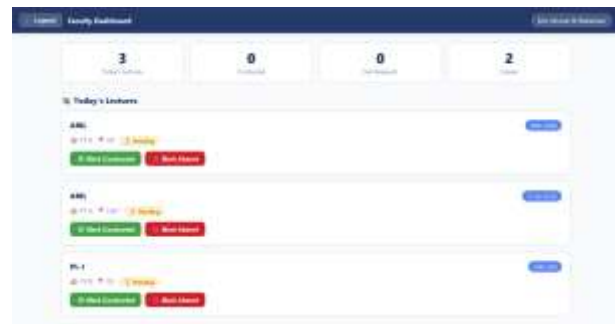


Fig. 2. Faculty Dashboard

D. Student Login Panel

The student login panel allows students to securely access their timetable and schedule updates.



Fig. 3. Faculty Login Panel



Fig. 4. Student Login Panel

E. General Login Interface

The system provides a simple and responsive login interface for different types of users.



Fig. 5. General Login Interface

X. FUTURE SCOPE

The project can be extended further by integrating artificial intelligence and predictive analytics for smarter timetable optimization. Future versions may include mobile applications for Android and iOS platforms, attendance integration, and synchronization with institutional ERP systems.

Advanced analytics dashboards can also help administrators analyze faculty workload, classroom utilization, and timetable efficiency.

XI. CONCLUSION

The Dynamic College Timetable Generator with Auto-Adjustment provides an effective and practical solution for handling timetable management in educational institutions. Traditional timetable preparation methods are often time-consuming, difficult to manage, and highly dependent on manual work. Even small changes such as faculty leave or classroom unavailability can disturb the entire schedule and create confusion among students and teachers. The proposed system helps overcome these problems by automating the timetable generation process and supporting intelligent real-time adjustments whenever disruptions occur.

The system focuses on generating conflict-free timetables while considering important academic constraints such as faculty availability, classroom allocation, laboratory sessions, and subject scheduling. One of the major advantages of the proposed solution is its ability to make minimal-impact adjustments instead of rebuilding the complete timetable whenever changes occur. This helps reduce administrative effort and improves overall scheduling efficiency.

The developed system also provides user-friendly dashboards for administrators, faculty members, and students, making timetable access and management simpler and more organized. Features such as notifications, secure login modules, and flexible timetable handling improve communication and reduce scheduling confusion within the institution.

Overall, the project demonstrates how automation and intelligent scheduling techniques can improve academic management systems in colleges. With future enhancements such

as mobile application support, AI-based optimization, and ERP integration, the system can become a more scalable and reliable solution for modern educational institutions.

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