



Hybrid Exam Planning System for Room and Invigilator Management Using AI

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Abstract— Examination management in educational institutions involves scheduling examinations, allocating classrooms, and assigning invigilators, all of which are often performed manually. These activities require considerable time and are susceptible to errors such as timetable conflicts, inefficient resource utilization, and last-minute changes. This project presents a Hybrid Exam Planning System for Room and Invigilator Management Using AI to automate examination planning and improve administrative efficiency. The system maintains a centralized database containing student, faculty, and room information to support automatic timetable generation, room allocation, and invigilator assignment. AI-based scheduling is used to produce balanced and conflict-free allocations while providing mechanisms for conflict detection and resource reallocation when faculty or room availability changes. A web-based dashboard enables administrators to monitor examination activities, manage resources, and generate seating plans and invigilation schedules. The proposed system reduces manual effort, improves scheduling accuracy, enhances resource utilization, and provides a transparent approach to examination management. Its scalable design allows deployment across institutions with different examination requirements, offering a practical solution for efficient and reliable exam administration.

Keywords— Artificial Intelligence, Examination Management, Exam Scheduling, Room

Allocation, Invigilator Assignment, Resource Management.

1. INTRODUCTION

Examination management is an essential administrative process in educational institutions that requires careful coordination of examination schedules, classroom allocation, and invigilator assignments. These activities are traditionally performed manually, which often requires significant time and effort while increasing the possibility of human errors. Common issues include timetable clashes, improper room allocation, unequal distribution of invigilation duties, and difficulties in handling last-minute changes such as faculty unavailability or room maintenance. As the number of students, courses, and examination sessions continues to grow, managing these activities efficiently becomes increasingly challenging. [6]

To overcome these limitations, this project proposes a Hybrid Exam Planning System for Room and Invigilator Management Using AI. The system is designed to automate examination-related activities by using a centralized database that stores information about students, faculty members, room capacities, and examination schedules. AI-assisted scheduling techniques are used to generate examination timetables, allocate rooms based on capacity, and assign invigilators according to their availability while reducing scheduling conflicts and improving resource utilization. The proposed system also includes conflict detection and dynamic reallocation features to manage unexpected



situations such as faculty absences or room unavailability. A web-based dashboard allows administrators to upload examination data, monitor scheduling activities, manage faculty and room information, and generate seating plans and invigilation schedules in real time. The automation of these tasks minimizes manual intervention, improves scheduling accuracy, and enhances transparency throughout the examination process. [5]

The system is designed with a modular and scalable architecture, making it suitable for institutions with different examination requirements. It supports systematic examination planning, efficient resource management, and reliable administrative operations while reducing workload and improving the overall effectiveness of examination management. [16]

II. RELATED WORK

Verma et al. (2020) presented the study "**Invigilator Duty Allocation in Examination Hall**" [1]. The authors focused on simplifying the process of assigning invigilators to examination halls by developing a Java-based allocation algorithm. The proposed system distributed examination duties fairly among faculty members while considering workload balance and reducing the possibility of repeated assignments. The algorithm minimized manual intervention and eliminated inconsistencies that commonly occur during conventional scheduling practices. By automating invigilator allocation, the system reduced administrative effort and improved the accuracy of examination planning. The authors also emphasized that automated duty allocation contributes to better resource utilization and ensures transparency in the assignment process. Experimental observations indicated that the proposed solution generated reliable duty schedules within a shorter period compared to manual methods. The study demonstrated that automation can significantly improve examination administration by providing a systematic and efficient approach to invigilator management in educational institutions. [1]

Mahmood et al. (2022) introduced an "**Intelligent Exam Supervision System Using Deep Learning Algorithms**" to strengthen examination monitoring through artificial intelligence [2]. The proposed framework employed deep learning techniques to observe students continuously during examinations and identify abnormal activities in real time. Face detection and behavioral analysis were integrated to recognize suspicious actions that could indicate violations of examination rules. The system reduced dependence on manual invigilation by automatically

detecting unusual events and generating alerts whenever necessary. The authors reported that the deep learning model improved monitoring accuracy while maintaining continuous surveillance throughout the examination session. The framework was designed to support educational institutions in maintaining fairness and academic integrity without increasing administrative workload. Experimental evaluations demonstrated that intelligent monitoring systems can improve the reliability of examination supervision while providing faster and more consistent observation than traditional manual methods. [2]

Bello et al. (2024) proposed "**Hybrid Technologies and Genetic Algorithms Applied to School Lecture Timetable Generation**" to improve timetable preparation through optimization techniques [3]. The study combined genetic algorithms with rule-based optimization methods to produce efficient academic schedules while satisfying institutional constraints. The proposed approach considered factors such as classroom availability, faculty preferences, and scheduling conflicts during timetable generation. Instead of relying on manual planning, the algorithm searched for optimized solutions that balanced resource utilization and reduced clashes between scheduled activities. The authors demonstrated that hybrid optimization techniques improved the quality of generated timetables and minimized the time required for schedule preparation. Experimental analysis showed that the genetic algorithm effectively handled complex scheduling problems involving multiple constraints while maintaining flexibility for institutional requirements. The research highlighted the potential of evolutionary optimization methods for automating educational scheduling systems and improving overall planning efficiency. [3]

Prosad et al. (2022) presented the work "**Design of Class Routine and Exam Hall Invigilation System Based on Genetic Algorithm and Greedy Approach**" [4]. The proposed framework combined two optimization techniques to automate academic scheduling and invigilator allocation. A genetic algorithm was applied to generate efficient class routines, while a greedy algorithm was used to assign invigilators based on availability and operational requirements. This combination enabled the system to satisfy scheduling constraints while reducing resource conflicts and administrative effort. The automated allocation process improved fairness in invigilator distribution and minimized manual errors that often occur during examination planning. The authors observed that integrating optimization algorithms produced reliable scheduling outcomes within a shorter execution time. Experimental results indicated that the



proposed approach effectively managed examination resources and provided a practical solution for educational institutions seeking to improve timetable generation and invigilation management through automation. [4]

Wong et al. (2002) presented "**Final Exam Timetabling: A Practical Approach**" to address the challenges associated with examination scheduling in academic institutions [5]. The authors proposed a rule-based scheduling method that generated examination timetables while reducing conflicts among courses and student examinations. The framework considered institutional constraints such as examination duration, available rooms, and student enrollment to produce feasible schedules. The proposed approach emphasized practical implementation rather than computational complexity, making it suitable for real-world educational environments. The scheduling strategy successfully minimized examination clashes and improved the organization of examination activities. The authors demonstrated that systematic rule-based scheduling could significantly reduce the effort required for manual timetable preparation while ensuring efficient utilization of available resources. The study provided an effective foundation for later research on automated examination scheduling and remains an important contribution to educational timetable optimization. [5]

III.DATASET DETAILS

The proposed Hybrid Exam Planning System does not rely on a publicly available dataset for training or evaluation. Instead, it operates on structured institutional data provided by the examination branch. The required information is stored in separate CSV files that serve as input to the scheduling system. These files include details of students, examination rooms, and invigilators, which are processed to generate examination schedules, seating plans, and invigilator assignments. The system also supports external configuration files to maintain a centralized repository and simplify data management.

The primary datasets used in the system are:

- **Students Dataset (students.csv):** Contains student information such as roll numbers and other required details for generating seating arrangements. The system reads the student records and assigns them to examination rooms while maintaining the predefined seating capacity.
- **Rooms Dataset (rooms.csv):** Stores room identifiers, room numbers, building information, and seating capacity. This dataset is used to allocate students

efficiently and ensure optimal utilization of available examination halls.

- **Invigilators Dataset (invigilators.csv):** Includes faculty information such as invigilator identification, department, and availability. The system uses this information to assign invigilators fairly across examination rooms while considering their availability.
- **Exam Schedule Data:** Contains examination details including subject, date, time, allocated room, and assigned invigilator. This information is generated and maintained by the system for examination management.

IV.PROPOSED METHODOLOGY

The proposed **Hybrid Exam Planning System for Room and Invigilator Management Using AI** is designed to automate examination planning by integrating centralized data management with an AI-assisted scheduling mechanism. The system processes institutional data related to students, examination rooms, faculty members, and examination schedules to reduce manual effort and improve the efficiency of examination management. All required information is maintained in structured CSV files and stored in a centralized repository, allowing the scheduling engine to access updated records during examination planning.

Initially, the administrator uploads the student, room, and invigilator datasets into the system. The scheduling engine validates the uploaded information and extracts details such as student roll numbers, room capacities, faculty availability, examination dates, and time slots. This preprocessing stage ensures that incomplete or inconsistent records do not affect subsequent scheduling operations.

The core of the proposed system is the **AI-assisted scheduling engine**, which automatically generates examination schedules, allocates rooms, and assigns invigilators according to predefined institutional constraints. During seating allocation, the system reads the student records, randomizes the student list to avoid fixed seating patterns, and distributes students among available examination rooms while respecting the seating capacity of each room. Similarly, faculty members are assigned to examination halls based on their availability, ensuring balanced invigilation duties and reducing scheduling conflicts. To improve scheduling reliability, the system incorporates **conflict detection and dynamic reallocation** mechanisms. These modules continuously examine examination schedules, room assignments, and faculty availability to identify timetable clashes or unavailable resources. Whenever a conflict is detected, the system automatically reallocates



available rooms or invigilators without disturbing the remaining examination schedule. This capability minimizes administrative intervention and enables efficient handling of last-minute changes. Finally, the generated examination timetable, seating plan, and invigilation schedule are presented through a web-based dashboard. The system also produces downloadable reports that assist administrators in monitoring examination activities and managing resources effectively. By combining centralized data management, automated scheduling, conflict detection, and dynamic resource allocation, the proposed methodology provides a systematic and reliable solution for examination planning while reducing manual workload and improving overall operational efficiency.

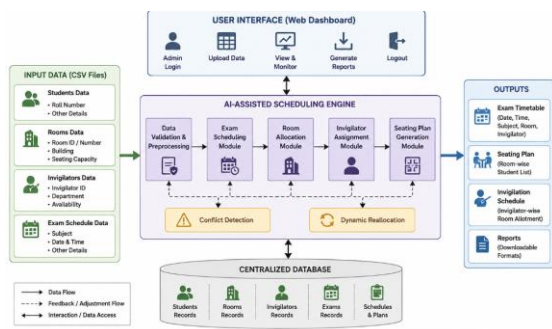


Figure 1: System Architecture of the Proposed Clean Bot – Intelligent LLM-Powered Data Quality Agent

Figure 1 illustrates the overall architecture of the proposed Clean Bot, an intelligent LLM-powered data quality management system. The process begins with the Frontend Layer, where users upload datasets through a Streamlit-based user interface. The system accepts multiple input formats, including CSV, JSON, and text files. The uploaded data are passed to the Input Layer, where preprocessing operations prepare the data by organizing the input and handling initial inconsistencies. The processed data are then forwarded to the Processing Layer, which consists of a locally deployed LLM Engine (Ollama) along with validation and transformation modules. This layer performs semantic analysis, anomaly detection, data cleaning, normalization, and intelligent validation to improve overall data quality. After processing, the cleaned information is converted into a structured JSON format in the Output Layer. Finally, the optional Storage Layer stores both the original and processed datasets, while the Security Layer ensures secure local LLM execution, protecting sensitive data and enabling reliable, scalable, and privacy-preserving data quality management.

V.RESULT AND DISCUSSION



Figure 2: Question Paper Distributor/Receiver Module

Figure 2 presents the **Question Paper Distributor/Receiver** module of the proposed Hybrid Exam Planning System. This interface is developed to manage the assignment of faculty members responsible for distributing and receiving question papers during examinations. The module is integrated into the administrator dashboard, allowing authorized users to generate and review faculty assignments efficiently. The central panel displays the list of allocated faculty members in a structured format, enabling administrators to verify the assignments before the examination process begins. A **Generate Assignments** option is provided to automatically create faculty allocations based on the available examination data, reducing manual effort and ensuring organized duty distribution. After generating the assignments, administrators can review the information or return to the home page for further examination management activities. This module improves coordination among examination staff, supports systematic handling of confidential question papers, reduces administrative complexity, and contributes to a more reliable and transparent examination management process.

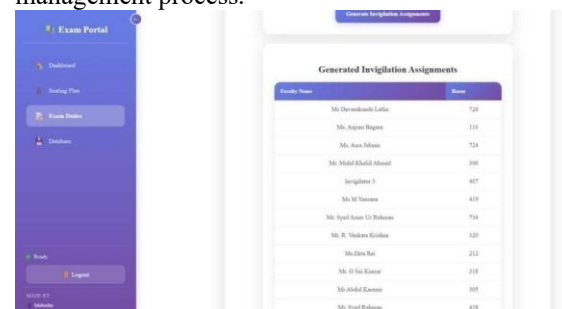


Figure 3: Generated Invigilation Assignments

Figure 3 illustrates the **Generated Invigilation Assignments** module of the proposed Hybrid Exam Planning System. This interface displays the automatically generated invigilation duties for faculty members after the scheduling process is completed. The assignment table presents faculty



names along with their corresponding examination room numbers, providing administrators with a clear and organized view of invigilator allocations. The system distributes duties based on the available faculty information and examination requirements, ensuring that each examination room is assigned an invigilator. By presenting the assignments in a structured tabular format, the module enables administrators to verify the generated schedule quickly and identify any required modifications before finalizing the examination plan. This automated approach minimizes manual effort, reduces the possibility of allocation errors, and improves coordination during examination management. The generated invigilation schedule supports efficient resource utilization, maintains transparency in faculty duty allocation, and contributes to the smooth execution of examination activities.

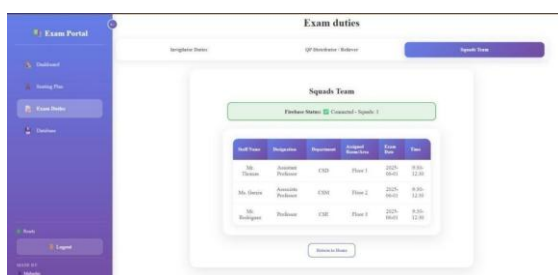


Figure 4: Squads Team Assignment Module

Figure 4 illustrates the **Squads Team Assignment** module of the proposed Hybrid Exam Planning System. This interface is designed to manage the allocation of faculty members responsible for supervising examination activities across different examination centers. The module displays a structured table containing faculty names, designations, departments, assigned roles, floor numbers, and room numbers. This organized presentation enables administrators to verify the responsibilities assigned to each faculty member before the commencement of examinations. The system automatically generates squad assignments based on the available faculty information, ensuring systematic distribution of supervisory duties and minimizing manual intervention. A confirmation message is displayed after successful assignment generation, indicating that the process has been completed without errors. The **Return to Home** option allows administrators to navigate back to the main dashboard for further examination management tasks. This module improves coordination among supervisory staff, supports efficient examination monitoring, enhances transparency in duty allocation, and contributes to the effective administration of examination activities.

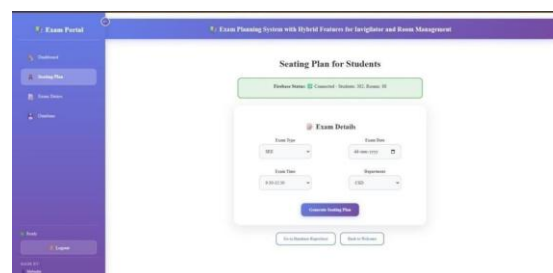


Figure 5: Student Seating Plan Generation Module

Figure 5 illustrates the **Student Seating Plan Generation** module of the proposed Hybrid Exam Planning System. This interface enables the administrator to generate examination seating arrangements by entering the required examination details. The module provides input fields for selecting the examination type, examination date, examination time, and department before initiating the seating allocation process. After the required information is entered, the administrator can generate the seating plan using the **Generate Seating Plan** option. The system processes the uploaded student and room data to prepare a structured seating arrangement while considering the available room capacity. The interface also includes options to generate student reports and return to the home page for additional examination management tasks. This module simplifies the preparation of seating arrangements, minimizes manual effort, improves the accuracy of student allocation, and ensures an organized examination environment by systematically assigning students to available examination halls.

DISCUSSION

The proposed **Hybrid Exam Planning System for Room and Invigilator Management Using AI** integrates centralized data management with an AI-assisted scheduling mechanism to simplify examination administration. The system follows a structured workflow that begins with uploading institutional datasets, including student, room, invigilator, and examination information in CSV format. During the initial stage, the uploaded data are validated and organized to ensure consistency before scheduling operations are performed. The scheduling engine automatically generates examination timetables, allocates students to examination rooms according to seating capacity, assigns invigilators based on faculty availability, and prepares seating plans for each examination session. Conflict detection and dynamic reallocation mechanisms continuously identify scheduling issues and automatically adjust room or faculty assignments whenever required. The generated timetable, seating arrangements, invigilation duties,



and examination reports are displayed through a web-based dashboard, allowing administrators to review and manage examination activities efficiently. The experimental implementation demonstrates that the proposed system reduces manual workload, minimizes scheduling errors, improves resource utilization, and provides a systematic approach for conducting examinations. Its modular architecture and centralized database support reliable examination management and allow the system to be adopted by institutions with different examination requirements.

VI. CONCLUSION

The proposed **Hybrid Exam Planning System for Room and Invigilator Management Using AI** provides a systematic solution for automating examination planning and resource management in educational institutions. The system integrates centralized data management, data validation, AI-assisted scheduling, room allocation, invigilator assignment, conflict detection, dynamic resource reallocation, and seating plan generation within a unified platform. Administrators can upload institutional data through a web-based interface, allowing the system to automatically generate examination timetables, seating arrangements, and invigilation schedules with minimal manual intervention. The centralized database ensures efficient management of student, faculty, room, and examination records while improving scheduling accuracy and resource utilization. The generated reports and dashboard enable administrators to monitor examination activities and make necessary modifications whenever required. The implementation demonstrates that the proposed system minimizes scheduling conflicts, reduces administrative workload, improves transparency in duty allocation, and supports reliable examination management. The modular architecture also allows future enhancements such as integration with institutional ERP systems, advanced scheduling optimization techniques, automated notification services, and support for additional examination management features, making the system adaptable to the evolving requirements of educational institutions.

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