International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 03 | March - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Exam Seating Arrangement System

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ABSTRACT

The manual process of exam seating arrangement in educational institutions is often time-consuming, error-prone, and lacks transparency. To address these challenges, a web-based Exam Seating Arrangement System has been developed to automate and systematize the allocation process. The system is built using Angular for frontend development, Node.js with Express.js for backend processing, and MongoDB as the primary database with MySQL integration for structured data management. Unlike traditional random seating approaches, the proposed system maintains strict enrollment number order branch-wise while implementing a branch alternation strategy to prevent same-branch adjacency. For example, students from Computer Engineering (CO) and Mechanical Engineering (ME) are seated in an alternating pattern such as CO–ME–CO–ME while maintaining ascending enrollment numbers. The system also manages room capacity efficiently by automatically shifting excess students to subsequent rooms while preserving the seating logic. This structured and automated approach enhances fairness, reduces malpractice risk, ensures optimal room utilization, and improves administrative efficiency.

Keywords

Exam Seating System, Angular, Node.js, Express.js, MongoDB, MySQL, Branch Alternation, Web Application, Automation

I. INTRODUCTION

Examination management is a crucial administrative function in educational institutions, where seating arrangement plays an important role in maintaining fairness and discipline. Traditional manual or spreadsheet-based seating methods are often time-consuming, prone to human error, and may result in students from the same branch being seated adjacent to each other, increasing the risk of malpractice. Random seating systems, although automated, usually fail to maintain enrollment order and proper branch distribution.

To address these challenges, a web-based Exam Seating Arrangement System has been developed to automate and organize the seat allocation process. The system is built using Angular for the frontend, Node.js with Express.js for backend processing, and MongoDB with MySQL for data management. The key feature of the system is its branch alternation algorithm, which maintains students' enrollment numbers in ascending order while seating different branches in an alternating pattern (e.g., CO–ME–CO–ME). The system also manages room capacity efficiently by automatically shifting excess students to the next room while preserving the seating logic.

This structured approach enhances transparency, reduces administrative workload, ensures fair distribution, and improves overall examination integrity in large institutions.

II. LITERATURE REVIEW

Automation of examination seating arrangements has gained attention due to the limitations of manual allocation methods. Traditional systems are time-consuming, prone to human errors, and often fail to ensure proper student distribution. To overcome these issues, several researchers have proposed automated seating systems.

In [1], the authors developed a structured exam seating arrangement system aimed at reducing manual effort and improving transparency. Although the system enhanced efficiency, it mainly focused on digitization rather than implementing structured enrollment sequencing with branch-based separation.

Similarly, the system proposed in [2] introduced an automated seat allocation mechanism for final-year examinations. The approach improved seat distribution and minimized administrative workload. However, it did not emphasize maintaining strict enrollment order or preventing same-branch adjacency through a defined alternation pattern.

The study in [3] presented an automated exam hall allotment system based on room capacity and student data management. While the system effectively reduced human intervention and improved operational efficiency, it lacked a systematic branch alternation strategy to ensure fair seating distribution.

From the reviewed literature, it is observed that existing systems focus primarily on automation and room allocation. However, there remains a gap in integrating strict enrollment sequencing with a rule-based branch alternation mechanism. The proposed Exam Seating Arrangement System addresses this gap by combining ascending enrollment order with a structured branch alternation logic to enhance fairness, transparency, and malpractice prevention.

III. METHODOLOGY AND PROPOSED SYSTEM

The proposed Exam Seating Arrangement System is designed as a web-based automated solution that integrates structured enrollment sequencing with a branch alternation algorithm. The methodology focuses on ensuring fairness, transparency, and efficient room utilization while minimizing manual intervention.

4.1 System Architecture

The system follows a full-stack architecture consisting of frontend, backend, and database layers:

1. **Frontend Layer:** Developed using Angular, it provides an interactive and user-friendly interface for administrators to upload student data, configure room capacity, and generate seating arrangements.

2. **Backend Layer:** Implemented using Node.js with Express.js, the backend processes student data, executes the seating algorithm, and manages room allocation logic.

3. **Database Layer:** MongoDB is used as the primary database to store student records and seating data, while MySQL is used for structured relational data management where required. This hybrid approach ensures flexibility and scalability.

4. **Version Control:** Git and GitHub are used for source code management and collaborative development.

4.2 Seating Allocation Algorithm

The core functionality of the system is based on a structured rule-based algorithm. The methodology follows these steps:

1. **Data Collection and Sorting**
Student data is collected branch-wise and sorted in ascending order based on enrollment numbers.
2. **Branch Selection**
Two or more branches are selected for alternation (e.g., Computer Engineering and Mechanical Engineering).
3. **Branch Alternation Logic**
Students are assigned seats in an alternating pattern such as:
CO – ME – CO – ME
This prevents same-branch adjacency while maintaining fairness.
4. **Enrollment Continuity Maintenance**
Within each branch, enrollment numbers remain in ascending order to ensure systematic record organization.
5. **Room Capacity Verification**
The system continuously checks room capacity during seat allocation.
6. **Automatic Room Shifting**
If the capacity of a room is reached, the remaining students are automatically shifted to the next room while preserving the alternation pattern and enrollment sequence.

7. **Final Seat Generation**
The final seating layout is generated and displayed for administrative review and printing.

4.3 Key Functional Features

1. Prevention of same-branch adjacency
2. Sequential enrollment maintenance
3. Automated room allocation
4. Scalable design for large institutions
5. Reduced administrative workload

This methodology ensures that the seating arrangement is not only automated but also logically structured to maintain fairness and examination integrity.

IV. COMPARATIVE ANALYSIS

The proposed Exam Seating Arrangement System is compared with existing examination seating systems presented in earlier studies.

Most existing systems focus mainly on automating room allocation and reducing manual work. However, they often allocate seats randomly or only based on availability without maintaining strict enrollment order or structured branch alternation. While these systems improve administrative efficiency, they may not effectively prevent same-branch adjacency.

In comparison, the proposed system introduces a structured branch alternation algorithm (e.g., CO–ME–CO–ME) while maintaining ascending enrollment order within each branch. This ensures systematic record organization and reduces the possibility of malpractice. Additionally, the automatic room-shifting mechanism maintains the same seating pattern even when room capacity is exceeded, which improves scalability for large institutions.

Therefore, compared to existing approaches, the proposed system provides:

- Better prevention of same-branch adjacency
- Maintenance of sequential enrollment order
- Improved fairness and transparency
- Efficient room utilization
- Higher scalability for large-scale examinations

This comparative analysis shows that the proposed methodology enhances both organizational structure and examination integrity beyond traditional automated seating systems.

V. NOVELTY OF THE PROPOSED SYSTEM

The novelty of the proposed Exam Seating Arrangement System lies in its structured and rule-based seat allocation mechanism, which differs significantly from traditional random or availability-based systems.

1. **Strict Branch Alternation Mechanism:**
The system introduces a deterministic branch alternation pattern (e.g., CO–ME–CO–ME) to prevent same-branch adjacency, thereby reducing the possibility of malpractice during examinations.

2. **Sequential Enrollment Preservation:**
Unlike existing systems, the proposed approach maintains ascending enrollment order within each branch, ensuring systematic and traceable record organization.

3. **Pattern Continuity Across Multiple Rooms:**
When room capacity is exceeded, the seating pattern continues seamlessly in the next room without breaking the alternation logic.

4. **Hybrid Data Management Approach:**
The integration of MongoDB and MySQL enhances both flexibility and structured data handling.

5. **Fair and Transparent Allocation Logic:**
The deterministic algorithm ensures fairness, optimal room utilization, and scalability for large institutions.

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, the proposed Exam Seating Arrangement System presents a structured and automated solution for managing examination seating in colleges and universities. Unlike conventional manual or random-

based seating approaches, the system implements a deterministic branch alternation algorithm combined with sequential enrollment number maintenance. This ensures that students from the same branch are not seated adjacently while preserving systematic record organization.

The integration of Angular for the frontend, Node.js with Express.js for backend processing, and MongoDB with MySQL for data management provides a robust and scalable architecture. The automatic room capacity handling and seamless shifting of remaining students to subsequent rooms enhance operational efficiency. Overall, the system reduces administrative workload, minimizes human error, ensures fair distribution, and strengthens examination transparency and integrity. The proposed solution is particularly suitable for large institutions with multiple branches and high student intake.

VII. FUTURE SCOPE

Although the proposed system effectively addresses major limitations of traditional seating arrangements, several enhancements can further improve its functionality and scalability.

Future improvements may include the integration of advanced optimization algorithms or AI-based seat distribution techniques to handle complex multi-branch and multi-floor scenarios more efficiently. A real-time administrative dashboard can be implemented for dynamic monitoring of room allocation, student distribution, and seat availability. Additionally, incorporating a student portal would allow individuals to securely access their seating details prior to examinations.

The system can also be integrated with institutional ERP platforms to enable automatic synchronization of student records. Development of a mobile-based application for administrators and faculty members would further increase accessibility and usability. With these enhancements, the system can evolve into a comprehensive and intelligent examination management platform capable of supporting large-scale academic environments.

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