IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Development Of Data-Driven Real-Time Dashboard

[1]M. Divya Niharika, [2]R. Shanmuka Siva Sai Ram, [3]M. Goutham, [4]Sk. Salma [5]Dr. B. V. Subba Rao

[1-4] IV B. Tech, Department of Information Technology, Prasad V Potluri Siddhartha Institute of Technology, Vijayawada, India.

[5] Professor and HOD, Department of IT, Prasad V Potluri Siddhartha Institute of Technology, Vijayawada, India

Abstract: Data-driven decision-making is essential to improving institutional performance and efficiency in today's educational environment. This project uses the MERN stack (MongoDB, Express.js, React, and Node.js) to develop a real-time dashboard for an educational institution. Staff may readily obtain relevant information thanks to the dashboard's comprehensive insights into student and teacher data, which includes attendance records, certificates, grades, hobbies, talents, strengths, and weaknesses. By offering a user-friendly and dynamic visual representation of information, the technology seeks to increase the effectiveness of data management. Employees can view and analyze data in real time, but only the administrator has the ability to change records, ensuring data security and integrity. Using a dynamic frontend powered by React, a robust backend utilizing Node.js and Express.js, and effective data storage using MongoDB, the dashboard leverages the MERN stack to deliver a flawless user experience. By facilitating quicker access to vital information, encouraging better decision-making, and enhancing the overall educational experience for both teachers and students, this project ultimately aims to enhance institutional operations.

Index Terms: Dashboard system, faculty and student information management, attendance tracking, role-based access control, and the MERN stack (MongoDB, Express, React, and Node.js)

1. INTRODUCTION

In today's digital age, educational institutions generate vast amounts of data about their students and faculty. Making well-informed decisions, improving academic performance, and streamlining administrative processes all depend on effectively managing and analyzing this data. Spreadsheets and paper records are examples of traditional systems that lack real-time access and are laborious and prone to errors. It gets harder to manually manage such vast volumes of data as institutions expand, which leads to inefficiencies in monitoring staff contributions and student achievement.

To solve these difficulties, this project will create a real-time dashboard for an educational institution utilising the MERN stack (MongoDB, Express.js, React, and Node.js)[7]. The dashboard functions as a centralised platform, allowing staff to easily access critical information such as student grades, attendance records, certificates, and shortcomings. Faculty-related data, such as attendance and certifications, are also included, providing a complete picture of academic and administrative performance.

In order to ensure data integrity and security, the power to edit or alter records is limited to the administrator, ensuring that only authorised individuals make changes. The dashboard provides a responsive and interactive user experience using the MERN stack, providing smooth data retrieval, real-time changes, and fast communication between the frontend and backend. The system's robust and scalable architecture not only

increases institutional efficiency but also allows for strategic decision-making, thereby improving the overall educational experience for students and faculty.

2. LITERATURE REVIEW

The integration of real-time data visualisation and dashboards into educational institutions is a burgeoning area of research and application. This section looks at existing research, technologies, and systems that focus on dashboard development, educational data management, and decision-making. The literature review also discusses the issues that educational institutions face when managing large volumes of data, as well as how dashboard systems might increase efficiency and usability.

Recent studies have explored the effectiveness of Learning Analytics Dashboards (LADs) in educational settings. A systematic review by Jivet et al. [4] synthesized findings from 38 research studies to investigate the impact of LADs on students 'learning outcomes. The review concluded that while LADs hold promise for enhancing Learning, their effectiveness is contingent upon factors such as design, implementation, and user engagement.

Hoffman et al. [5] presented the design and evaluation of data dashboards built specifically for a school district. They outlined five guiding principles for dashboard design: usability, relevance, clarity, interactivity, and accessibility. These principles aim to ensure that dashboards effectively support educators in managing and interpreting student data.

2.1 EXISTING EDUCATIONAL DASHBOARD SYSTEMS

Dashboards are increasingly being used by educational institutions to track and analyse data about their students and teachers. Many existing Learning Management Systems (LMS) such as Moodle, Blackboard, and Canvas have dashboard features for managing student participation, attendance, and academic success. However, while these systems provide vital insights into student learning, they frequently fall short of combining data from numerous sources, such as administrative operations, student and instructor performance.

2.2 CHALLENGES IN EDUCATIONAL DATA MANAGEMENT

For institutions, managing educational data is a constant problem, particularly when the volume of data increases rapidly. The fragmentation of data across several platforms, which makes it challenging to combine into a single source of truth, is one of the main problems with educational data management, claim Lee and Lee [1]. Data is frequently kept by institutions in a variety of formats, including spreadsheets, physical documents, and distinct digital databases. Decision-making may become even more difficult as a result of this fragmentation, which may result in inefficiencies and inconsistencies.

The absence of real-time data processing is a major obstacle. Even when organisations collect data on a regular basis, accessing current information is challenging due to manual processing and reporting methods. Timely decision-making and institutional efficiency are hampered by this delay in data availability. To make well-informed judgements based on the most recent data, educational leaders need tools that allow for real-time monitoring and reporting.

Furthermore, a major obstacle to the broad adoption of data management systems has been the lack of an engaging and user-friendly user interface (UI) in many of them. Complex data visualisation techniques are frequently challenging for non-technical consumers to employ. Because administrators and employees may be hesitant to use systems that call for specific technical knowledge, this can lead to lower adoption rates of data systems.

2.3 ROLE OF DASHBOARDS IN EDUCATION

Dashboards are becoming more and more acknowledged as crucial instruments for turning unprocessed data into useful insights, particularly in the field of education. According to Zhang et al. [2], dashboards help school leaders make better decisions by giving them real-time access to key performance indicators (KPIs) such student attendance, grades, and engagement. Dashboards assist staff in tracking student progress, identifying patterns, and making proactive decisions by integrating sophisticated data analytics and visualisation tools.

For efficient administration, teacher information is just as important as student data. Dashboards that combine faculty and student data into a single platform provide a thorough understanding of institutional performance, according to Graham et al. [3]. Better planning, resource allocation, and academic support services are made possible by such a system. Administrators may efficiently manage the faculty roster by using dashboards to track faculty qualifications, certifications, and attendance.

Another study by Sun et al. [3] emphasises how dashboards may give teachers and students immediate feedback. Transparency and accountability are encouraged by the opportunity to visually clearly and engagingly track certificates, attendance, and academic achievement.

4.PROPOSED SYSTEM

The goal of the suggested system is to offer a complete answer to the problems that educational institutions encounter when trying to manage and use vast volumes of faculty and student data. This system will centralise important data including student grades, attendance, certifications, talents, strengths, and weaknesses, as well as faculty-related data like attendance and certificates, by creating a real-time dashboard with the MERN stack (MongoDB, Express.js, React, and Node.js). Staff members will be able to access all pertinent data from a single platform thanks to this centralised system, which will enhance decision-making and accessibility.

Modern technologies, such as MongoDB for the database, which offers flexibility and scalability in processing a variety of data kinds, will be used in the system's construction. A responsive, interactive user interface will be made with React.js, enabling staff members to see data through dynamic elements. In addition to managing authentication and handling API routes, the Node.js and Express.js backend will provide effective communication between the database and the frontend.

The system's main objective is to increase educational institutions' efficiency by giving them real-time access to extensive data about faculty and students. It will streamline manual labour, automate data management, and guarantee that personnel have easy access to all pertinent data for well-informed decision-making. The system's scalable architecture enables future growth and the addition of other data sources as required, enabling it to expand with the organisation.

The suggested solution will improve data security by guaranteeing that only authorised individuals can alter sensitive data, while also enhancing decision-making and institutional efficiency. With its comprehensive perspective of academic performance, attendance, certificates, and other important indicators in real-time, this system will eventually aid educational institutions in running more efficiently.

5. SYSTEM ARCHITECTURE

Here is a thorough analysis of the possible structure for the system architecture of the suggested project. The primary elements and their interactions are included in this architecture.

5.1 **USER INTERFACE**

- Technology: React.js
- Components:
  - Dashboard: Main interface for staff to view and manage student and faculty data. It includes sections for achievements, attendance, assignments, certifications, and grades.
  - Authentication Pages: Login page for staff and admin, using role-based access control to determine what data can be viewed or modified.
- Role-based Access:
  - Staff: Can view student and faculty data, achievements, attendance, assignments, and certifications.
  - Admin: Can view and modify data, manage user access, and update records.

5.2 **BACKEND**

- Technology: Node.js & Express.js
- Components:
  - API Layer: Exposes RESTful APIs to interact with the frontend. It handles requests for fetching and updating student and faculty data.
  - User Authentication: Middleware for user authentication, using JSON Web Tokens (JWT) to verify and protect routes.
  - Data Controller: A controller that processes data fetching and updating operations based on the API requests.
  - Role-based Access Control (RBAC): Middleware that checks user roles (Admin or Staff) before allowing any sensitive operations like data modification.

5.3 **DATABASE**

- Technology: MongoDB
- Components:
  - Collections:
    - Student Data: Stores student details like grades, performance, strengths, weaknesses, attendance, and certifications.
    - Faculty Data: Stores faculty-related information like attendance, certifications, and assignments.
    - Achievements: Stores records of student and faculty achievements.
    - Assignments: Stores data related to student assignments, deadlines, and submission statuses.

- User Data: Stores staff and admin login credentials, roles, and access levels.

6. RESULTS AND DISCUSSION

- The system significantly improves data accessibility, security, and efficiently for educational institutions as shown in the figure 1 and figure 2. Key results include:
- Enhanced Accessibility: Real-time data retrieval enables staff and administrators to quickly access necessary information without delays.
- Data Integrity and Security: Role-based access control ensures that only authorized personnel can modify sensitive data, maintaining accuracy and reliability.
- Administrative Efficiency: The dashboard eliminates manual record-keeping and reduces paperwork, marking data management more streamlined.
- Scalability: The system can accommodate future extensions, such as integrating additional data modules or linking with external educational tools.

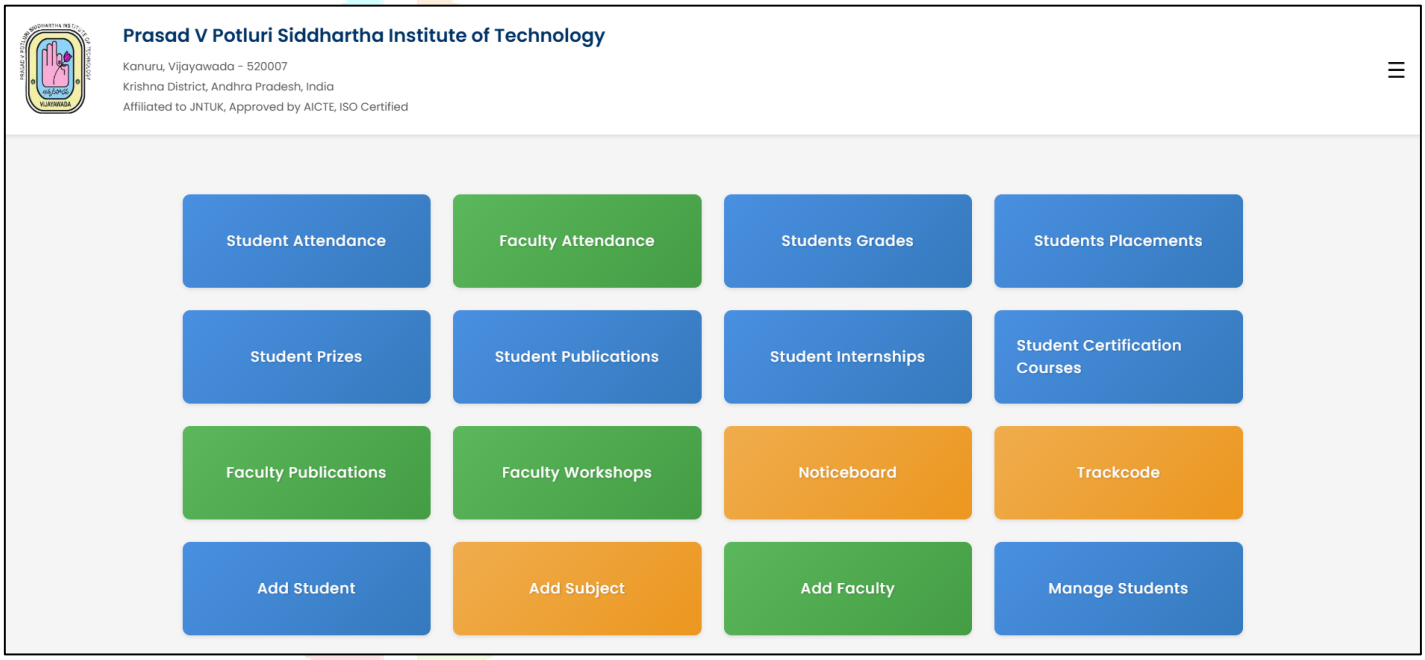

Figure – 1 Admin Home Page

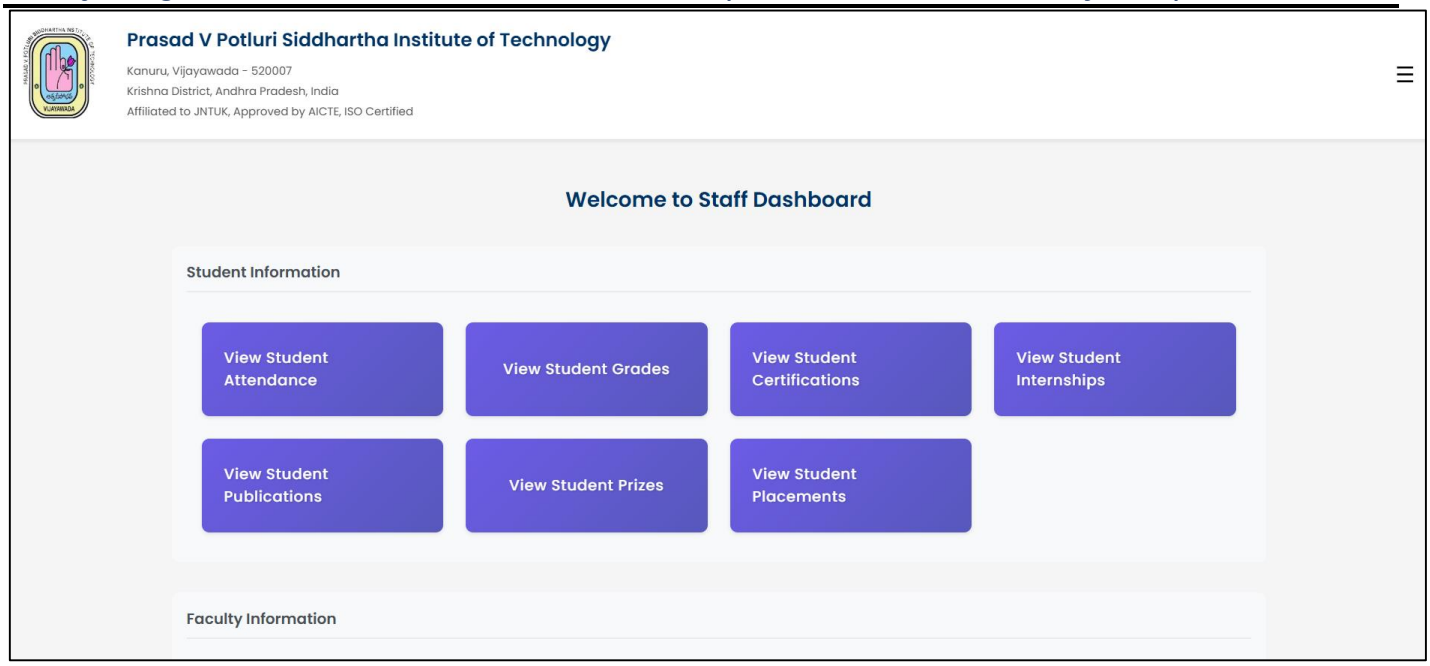

Figure – 2 Staff Home Page

7. CONCLUSIONS AND FUTURE SCOPE

- The proposed real-time dashboard provides an efficient solution for educational data management by centralizing and organizing student and faculty information. By enabling role-based data access and secure modifications, it enhances institutional decision-making and ensures reliable record-keeping.

Future Enhancements:

➢ Integration with Biometric Attendance Systems: Automating attendance tracking for higher accuracy.

➢ AI-based Analytics: Implementing predictive analytics for student performance analysis and faculty workload management.

➢ Mobile Application Development: Expanding accessibility for faculty and administrators via a dedicated mobile platform.

The integration of well-designed dashboards has been shown to support data-driven decision-making among educators, thereby enhancing teaching effectiveness and student outcomes. As highlighted by Michaeli et al. [6], the use of education dashboards is positively associated with teachers 'professional growth, particularly in areas such as facilitation, analysis, design, and citizenship. This project lays the foundation for a scalable, secure and efficient educational data management system that can be expanded to meet future institutional needs.

8. REFERENCES

[1] Lee, J., & Lee, S. (2021). "Challenges in Educational Data Management." *International Journal of Education & Technology,* vol. 15, no. 3, pp. 45-58.

[2] Zhang, H., et al. (2020). "Role of Dashboards in Education: A Data-Driven Approach." *Journal of Learning Analytics,* vol. 8, no. 2, pp. 25-40.

[3] Sun, R., & Graham, P. (2021). "Improving Institutional Efficiency with Real-Time Data Dashboards." *Educational Review Journal,* vol. 10, no. 1, pp. 12-30.

[4] Jivet, I., Scheffel, M., Specht, M., & Drachsler, H. (2023). Have Learning Analytics Dashboards Lived Up to the Hype? A Systematic Review of the Literature. *ACM Transactions on Computing Education*, 23(1), 1-33.

[5] Hoffman, E. S., Knight, S., & Dawson, S. (2019). Designing and Evaluating Data Dashboards for Educators. *International Journal for Educational Media and Technology*, 14(2), 3-14.

[6] Michaeli, Y., Kroparo, D., & Hershkovitz, A. (2020). Teachers' Use of Education Dashboards and Professional Growth. *Journal of Learning Analytics*, 7(3), 61-75.

[7] Pro MERN Stack, Vasan Subramanian, 2/e, Apress, 2019, ISBN: 978-1-4842-4390-9