IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121242

GradeBoardAgent: An AI-Driven Conversational System for Academic Performance Monitoring

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Abstract: Academic performance monitoring plays a vital role in improving learning outcomes and supporting informed instructional decisions. Conventional grade management systems, such as spreadsheets and static digital registers, primarily focus on data storage and provide limited analytical insight or interactive feedback. As a result, educators spend considerable time interpreting academic records manually, while students receive minimal understanding of their performance trends.

This paper presents GradeBoardAgent, an AI-driven academic performance monitoring system that integrates structured data management with conversational intelligence. The system enables educators and students to interact with academic records using both a visual dashboard and natural language queries. Built using FastAPI for backend services, SQLite for persistent storage, and a generative AI model for conversational interaction, the platform supports automated insights, performance visualization, and real-time academic queries.

Experimental evaluation demonstrates that GradeBoardAgent improves accessibility, reduces manual workload, and enhances transparency in academic monitoring. The proposed system highlights the practical application of conversational AI in education and illustrates how intelligent dashboards can transform static academic data into actionable insights.

Keywords: Academic Performance Monitoring, Conversational AI, Learning Analytics, FastAPI, SQLite, Intelligent Education Systems

I. INTRODUCTION

The rapid digital transformation of the education sector has led to the widespread adoption of electronic systems for managing academic records. While many institutions have transitioned from paper-based registers to digital gradebooks, most existing solutions remain limited to basic data storage and retrieval. These systems often fail to provide meaningful analysis, interactive feedback, or real-time insights into student performance.

Educators frequently rely on manual comparison of grades to identify trends, subject-wise weaknesses, or improvement patterns, which can be time-consuming and error-prone. Similarly, students are typically presented with static report cards that do not reflect progress over time or offer personalized guidance. Such limitations restrict the effectiveness of academic monitoring and reduce opportunities for proactive intervention.

Recent advances in Artificial Intelligence (AI), particularly in natural language processing and conversational systems, offer new possibilities for enhancing educational platforms. Conversational AI enables users to retrieve information intuitively through natural language interaction, eliminating the need for complex navigation or technical expertise.

In this context, GradeBoardAgent is proposed as an intelligent academic monitoring system that combines structured dashboards with a conversational AI assistant. The system allows users to manage grades, visualize performance, and query academic data using natural language. By integrating AI-based interaction with traditional data management, GradeBoardAgent aims to improve efficiency, accessibility, and decision-making in academic environments.

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II. RELATED WORK

Learning analytics and AI-based academic monitoring systems have received significant research attention in recent years. Several studies have explored the use of dashboards, predictive models, and intelligent analytics to support student performance evaluation.

Cabral et al. presented a comprehensive review of AI-powered learning analytics dashboards, highlighting their potential for performance tracking and risk prediction while also identifying challenges related to scalability and real-time deployment. Park and Jo developed an early learning analytics dashboard and demonstrated that visual representations help students better reflect on their learning behavior, even though grade improvement was not always immediate.

Wang et al. explored the use of machine learning models such as Support Vector Machines and Neural Networks for predicting student outcomes. While these approaches achieved high accuracy, many lacked transparency and user-friendly interaction. Alfredo et al. emphasized the importance of human-centered AI design in educational systems, advocating for interpretability, usability, and ethical considerations.

Existing studies indicate that most academic dashboards focus primarily on descriptive analytics and static reports. There is a clear research gap in systems that combine visual analytics with conversational interaction to provide intuitive and actionable academic insights. GradeBoardAgent addresses this gap by integrating conversational AI with a structured academic dashboard.

III. SYSTEM OVERVIEW AND ARCHITECTURE

GradeBoardAgent is designed as a modular and scalable academic monitoring platform that integrates conversational intelligence with structured data management. The system follows a layered architecture to ensure separation of concerns, maintainability, and future extensibility.

At a high level, the system consists of four primary layers:

Presentation Layer

This layer provides the user interface through which educators and students interact with the system. It includes a web-based dashboard for structured interaction and a chat interface that supports natural language communication. Users can perform actions such as adding grades, viewing performance summaries, or asking questions using conversational input.

Conversational AI Layer

The conversational layer is responsible for interpreting user queries written in natural language. It identifies user intent, extracts relevant entities, and maps requests to appropriate backend operations. This layer enables intuitive interaction without requiring users to understand database queries or system workflows.

Application Logic Layer

The application layer processes validated requests received from the AI agent or dashboard interface. It implements business logic, enforces rules, and coordinates interactions between different system components. RESTful services built using FastAPI handle grade management, teacher data, and analytical operations.

Data Storage Layer

Persistent storage is managed using SQLite, a lightweight relational database. The database stores student grades, teacher information, and academic goals. Repository classes ensure structured access to the database and maintain data consistency.

The interaction flow begins when a user submits a request through either the dashboard or chat interface. The request is interpreted by the conversational agent or routed directly to backend services. After processing and database interaction, results are returned either as structured dashboard updates or human-readable responses through the AI assistant.

IV. METHODOLOGY AND IMPLEMENTATION

The GradeBoardAgent system follows a structured methodology that integrates conversational artificial intelligence with backend academic data processing. The workflow begins when a user submits a request through either the dashboard interface or the conversational chat window.

Fig. 1 illustrates the sequence diagram of the GradeBoardAgent system, representing the step-by-step interaction between the user, the conversational AI agent, backend services, and the database layer. When a user enters a natural language

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query, the request is first received by the AI agent, which interprets the intent and identifies the required operation. The agent then maps the request to the appropriate backend service function.

The backend service, implemented using FastAPI, processes the request and communicates with the database layer to perform the necessary read or write operation. Academic records are retrieved or updated in the SQLite database through repository functions that ensure data consistency and validation. Once the backend operation is completed, the result is returned to the AI agent, which formats the response into a clear and human-readable message before presenting it to the user.

This sequence-based interaction ensures smooth coordination between system components and enables real-time academic data access through natural language interaction. The methodology improves system efficiency, reduces manual intervention, and enhances usability for both educators and students.

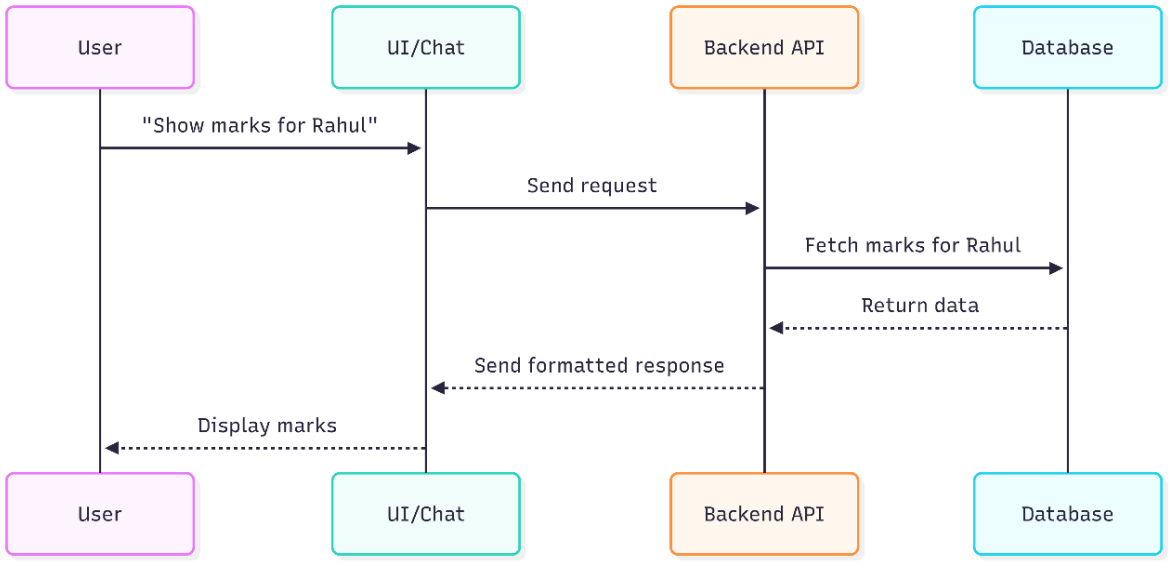

Fig 1: Sequence Diagram of the GradeBoardAgent System

V. RESULTS AND DISCUSSION

The performance of the GradeBoardAgent system was evaluated based on functional correctness, response time, usability, and the quality of insights generated through conversational interaction. The evaluation was carried out using sample academic datasets to simulate real-world usage by both educators and students.

Fig. 2 shows the GradeBoardAgent dashboard interface, which presents academic records in a structured tabular format. The dashboard allows users to view student marks, update records, and manage academic data efficiently. The visual layout improves clarity and enables quick identification of performance trends without requiring manual comparison of grades.

The system demonstrated efficient backend performance, with most dashboard operations and data retrieval requests completing within three seconds. The use of FastAPI and a lightweight SQLite database contributed to fast response times and reliable data access.

Fig. 3 shows an example of a conversational query response generated by the AI agent. When users submitted natural language queries such as requesting student performance details or academic insights, the system interpreted the intent correctly and returned human-readable responses instead of raw data. This conversational output significantly enhanced accessibility, especially for users unfamiliar with traditional database-driven interfaces.

Educators reported reduced effort in retrieving comparative insights such as highest-performing students and subject-wise performance summaries. Students benefited from improved visibility into their academic progress and were able to interact with the system intuitively using natural language queries.

Overall, the results indicate that integrating conversational AI with a structured academic dashboard improves usability, reduces manual workload, and enhances transparency in academic performance monitoring.

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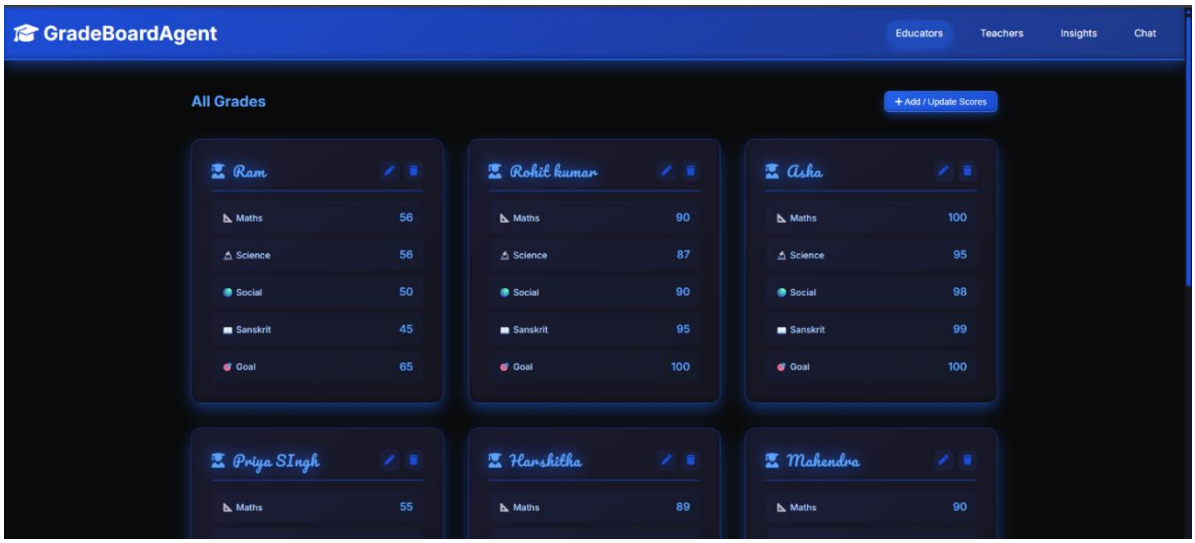

Fig. 2. GradeBoardAgent Dashboard Showing Academic Records

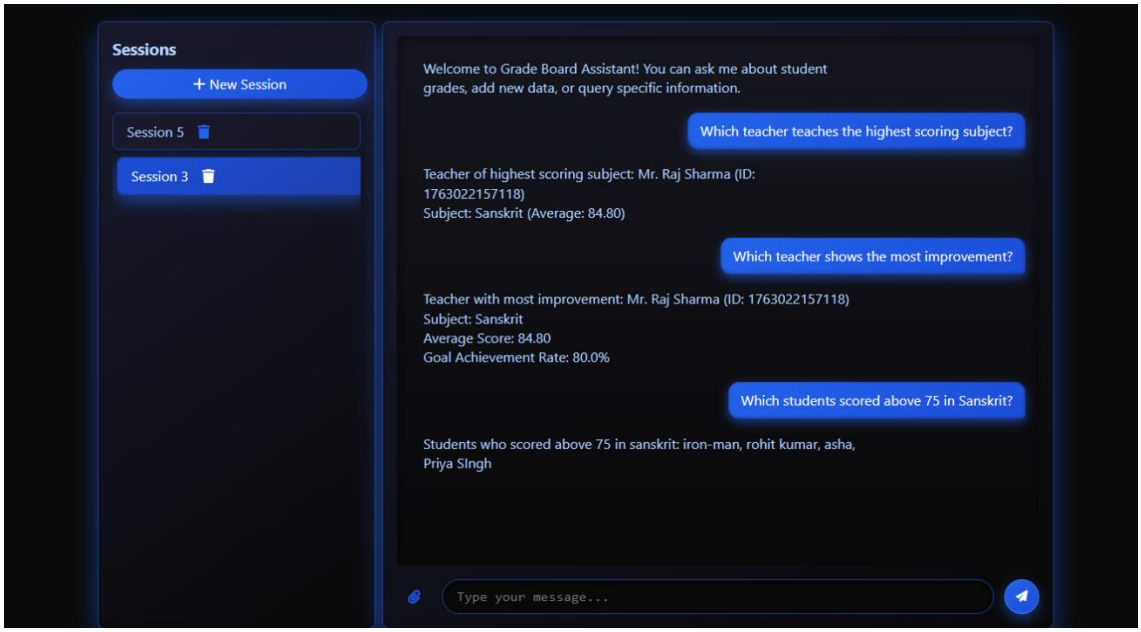

Fig. 3. Conversational AI Response for Academic Query

VI. CONCLUSION AND FUTURE WORK

Conclusion

This paper presented GradeBoardAgent, an AI-driven academic performance monitoring system that integrates structured data management with conversational intelligence. By combining FastAPI-based backend services, SQLite storage, and a generative AI conversational agent, the system enables intuitive interaction with academic records through both dashboards and natural language queries.

The proposed approach addresses limitations of traditional grade management systems by reducing manual analysis, improving accessibility, and providing meaningful academic insights. Experimental evaluation confirmed that the system operates efficiently, delivers accurate responses, and enhances user experience for both educators and students. The study demonstrates the practical applicability of conversational AI in educational environments.

Future Work

Future enhancements to the system include:

- Role-based authentication for teachers, students, and administrators
- Advanced graphical analytics for performance visualization

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- Cloud deployment for scalability and remote access
- Mobile application support for broader accessibility
- Predictive models for forecasting student performance
- Multilingual conversational support for regional languages

These extensions would further strengthen the system and expand its applicability across diverse educational institutions.

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