

EDUTRACK: AI BASED PERSONALIZED LEARNING THROUGH SECURE ANALYTICS

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College : New Horizon College of Engineering, Bengaluru
Branch : Department of Information Science and Engineering
Guide(s) : Prof. K Thamarai Selvi
Prof. Sriharshini Devi Kaipa
Student(s) : Mr. Santosh Kumar K
Ms. Shraddha Shenoy
Mr. Suhas S
Ms. Vidyashree H Shetty

Keywords:

AI powered platform, Adaptive learning, Personalized learning, Learning Analytics, Recommendation Systems, Student engagement, Machine Learning in education.

Introduction:

The evolving education landscape demands personalized solutions, as traditional one-size-fits-all methods often fail to address diverse learning needs effectively. This project presents an AI-powered learning platform for schools and colleges, aimed at improving both learning outcomes and academic management through structured, role-based dashboards for Admin, Teacher, and Student. Administrators manage institutional data and user access, teachers can upload study materials, conduct assessments, and analyze student performance, while students can access learning resources, attend tests, and track their academic progress. A key feature of the platform is adaptive learning, where the system analyzes student performance to identify weak areas and provide targeted recommendations, including personalized study materials and video content. Additionally, the platform integrates AI-driven doubt resolution using Natural Language Processing (NLP), enabling students to receive instant explanations and support. Built on the MERN stack, the system leverages machine learning techniques such as SVD for recommendations and Random Forest and Decision Trees for performance prediction, ensuring a scalable, responsive, and data-driven learning environment that enhances student engagement and overall academic success.

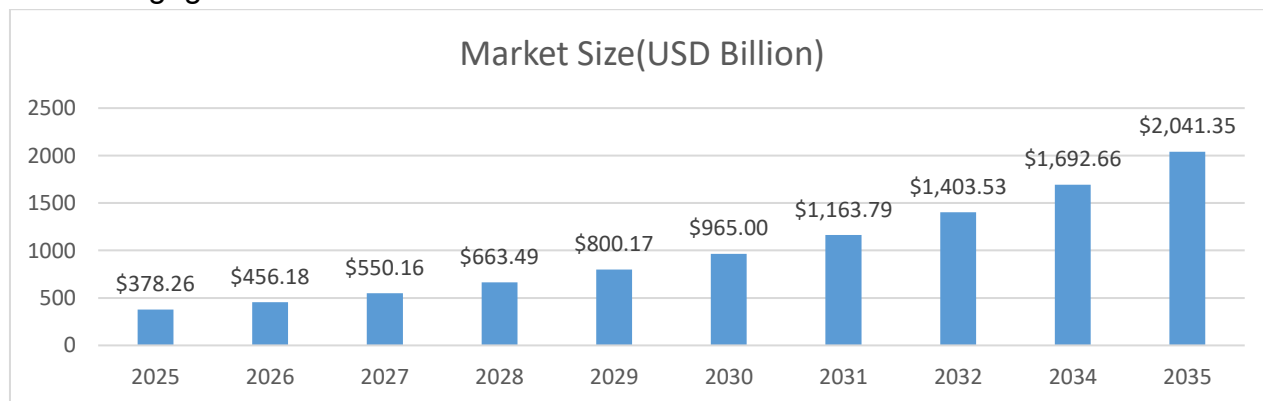


Figure 1: E-learning services Market Growth Rate

Objectives:

1. To develop a personalized video recommendation system using a hybrid method
2. To assess pupils' test scores and develop flexible, dynamic learning paths
3. To use an AI-powered chatbot for guided learning and instantaneous resolutions
4. To determine each person's distinct learning style and adjust content delivery accordingly

Methodology:

The proposed AI-powered learning platform is developed to create a personalized and adaptive learning environment for students in schools and colleges. The system architecture is designed using the MERN stack, which includes MongoDB for database management, Express.js and Node.js for backend services, and React for building a responsive and interactive user interface. The platform is structured with three primary user roles: Admin, Teacher, and Student. The Admin manages the system by creating and assigning login credentials for teachers and students and maintaining institutional data. Teachers upload course materials such as notes, videos, and assignments, and they can also create tests to evaluate student understanding. Students log in to the platform to access study materials, watch recommended educational videos, attend classes, and take quizzes. All user activities, including learning history, video interactions, and test scores, are stored in the database. The system collects and processes this interaction data to understand learning behavior and track student progress. A hybrid recommendation system is implemented to provide personalized video suggestions based on both student preferences and subject relevance. Collaborative filtering techniques analyze patterns among multiple students, while content-based filtering examines video topics and learning interests. Techniques such as Singular Value Decomposition (SVD) are applied to improve recommendation accuracy and relevance.

In addition to personalized recommendations, the system incorporates machine learning models to analyze academic performance and generate adaptive learning paths. Student test results are analyzed using algorithms such as Random Forest and Decision Trees to identify weak subject areas and knowledge gaps. Based on this analysis, the system dynamically recommends targeted study materials, additional videos, and practice quizzes to help students improve their understanding. The platform also integrates an AI-powered chatbot using services such as Gemini or OpenAI API to provide real-time doubt resolution and learning assistance. The chatbot uses Natural Language Processing (NLP) techniques to understand student questions and generate accurate explanations for academic concepts. This enables students to receive instant help without depending entirely on teacher availability. Furthermore, the platform analyzes user interaction patterns, such as video watch time, quiz attempts, and navigation behavior, to detect individual learning styles. Based on these insights, the system personalizes content delivery to match the student's preferred learning format. The development process also includes designing system architecture diagrams, data flow diagrams, and database schemas to ensure efficient communication between system components.

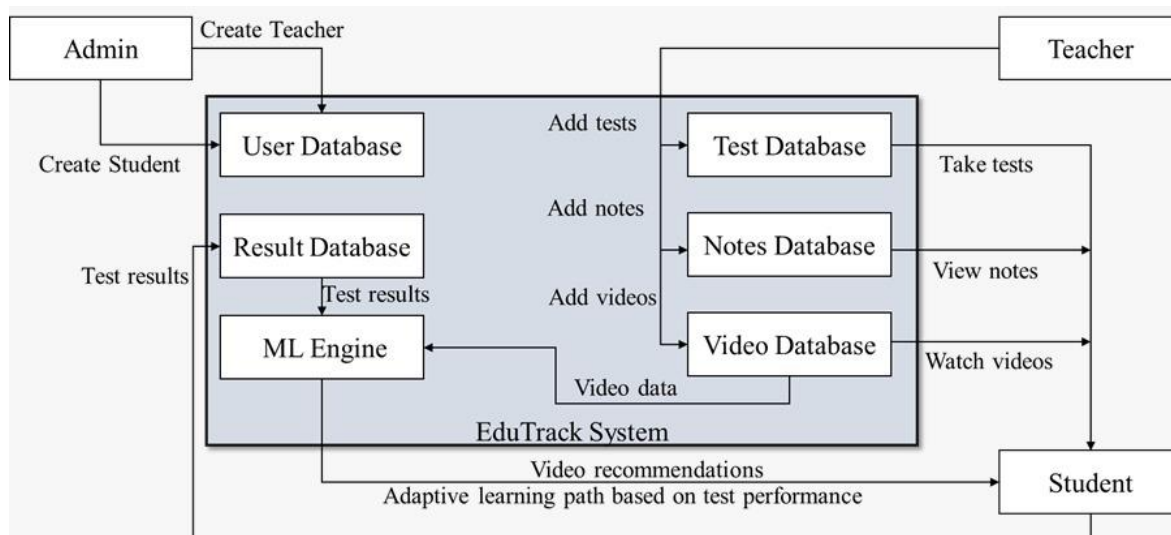


Figure 2: Data Flow Diagram

Result and Conclusion:

In conclusion, the developed AI-powered learning platform successfully demonstrates how intelligent technologies can improve digital education in schools and colleges. The system was implemented using the MERN stack consisting of MongoDB, Express.js, React, and Node.js to ensure a scalable and responsive architecture. The platform provides separate dashboards for Admin, Teacher, and Student roles, allowing structured management of academic activities. Teachers can upload notes, learning materials, and tests, while students can access study resources and track their academic progress. The system collects and stores student interaction data such as quiz scores, video views, and learning activity.

A hybrid video recommendation system was implemented to provide personalized learning content to students. By combining collaborative filtering and content-based filtering techniques, the system recommends relevant educational videos based on student preferences and learning history. Machine learning algorithms such as Random Forest and Decision Trees were applied to analyze student test performance and identify weak subject areas. Based on this analysis, the system generates adaptive learning suggestions including recommended videos and practice quizzes.

An AI-powered chatbot integrated using APIs such as Gemini enables students to resolve doubts instantly and receive concept explanations in real time. The platform also analyzes learning behavior to understand student preferences and personalize content delivery accordingly. The results show that the system improves student engagement and supports self-paced learning. Overall, the project demonstrates that integrating AI, recommendation systems, and learning analytics can significantly enhance the effectiveness of modern digital learning platforms.

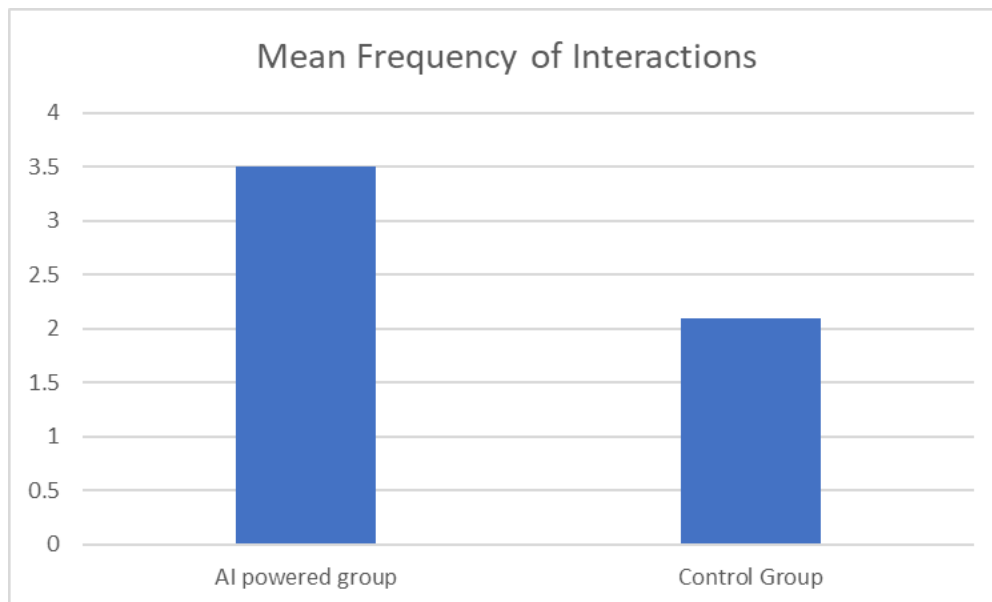


Figure 3: Mean Frequency of Interactions

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Future Scope:

The future scope of this project includes:

1. Enhancing the platform with advanced AI capabilities such as predictive analytics to identify at-risk students, deep learning models for improved personalization, and real-time adaptive learning based on student behavior and performance.
2. Expanding accessibility and learning experience through multilingual support, regional curriculum mapping, mobile applications, gamification, and integration of immersive technologies like AR/VR for interactive education.
3. Transforming into a complete academic ecosystem by integrating with ERP, LMS, and Student Information Systems, along with AI-driven content generation for quizzes and summaries, ensuring scalability and broader real-world applicability.