

E-Learning Platform with an AI Recommendation Engine

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Abstract - The rapid growth of digital technology has transformed traditional education into online learning systems. However, most existing e-learning platforms provide the same content to all learners without considering individual learning needs, abilities, and interests. This reduces engagement and learning efficiency. To solve this problem, this project proposes an **E-Learning Platform with an AI Recommendation Engine** that delivers personalized learning experiences to students. The system collects user data such as course history, quiz performance, time spent on topics, and learning preferences. Using Artificial Intelligence and Machine Learning algorithms, the platform analyses student behaviour and identifies strengths and weaknesses. Based on this analysis, the recommendation engine suggests suitable courses, practice materials, revision content, and advanced topics tailored to each learner. The platform includes features such as user registration, course management, video lectures, quizzes, performance tracking, and an interactive dashboard. The AI-based recommendation system improves learning efficiency by guiding students toward relevant study materials and helping them focus on weak areas.

This system enhances student engagement, supports self-paced learning, and increases overall academic performance. The proposed model can be applied in schools, colleges, competitive exam preparation, and corporate training environments. By integrating AI into e-learning, the platform creates a smarter and more adaptive educational ecosystem for modern learners.

Key Words:- E-Learning Platform, Artificial Intelligence (AI), Recommendation Engine, Machine Learning, Personalized Learning, Collaborative Filtering, Content-Based Filtering, Learning Analytic

I. INTRODUCTION

The advancement of internet technology and digital devices has significantly changed the education system. Traditional classroom learning is gradually being supported and replaced by online learning platforms. E-learning platforms allow students to access educational content anytime and anywhere, making learning more flexible and convenient. However, most existing platforms provide the same learning materials to all students, without considering their individual abilities, interests, and learning speed.

Every student has a different learning style. Some students understand concepts quickly, while others require additional practice and explanation. Providing the same content to all learners may reduce engagement and affect performance. Therefore, there is a need for a smart system that can understand student behavior and recommend suitable learning materials accordingly.



Fig-1: AI-Based E-Learning Recommendation Engine Architecture

To address this issue, the proposed system introduces an **E-Learning Platform with an AI Recommendation Engine**. The system uses Artificial

Intelligence and Machine Learning techniques to Analyze student activities such as quiz scores, course history, time spent on topics, and learning preferences. Based on this analysis, the platform provides personalized recommendations including courses, practice questions, revision materials, and advanced topics. The main goal of this system is to improve learning efficiency, increase student engagement, and provide a customized learning experience. By integrating AI into e-learning, the platform becomes more adaptive and intelligent, helping students focus on their weak areas and achieve better academic performance.

II. LITERATURE SURVEY

Predicting student academic performance has become a prominent research area in educational data mining (EDM) due to the increasing availability of student-related data generated by learning management systems (LMS), online platforms, and traditional classrooms. The objective of these systems is to leverage historical and real-time data to identify at-risk students, enhance instructional strategies, and improve overall educational outcomes. Early studies focused primarily on the use of traditional statistical techniques to explore relationships between student demographic attributes and academic success. Romero and Ventura (2007) pioneered the use of educational data mining to extract patterns from educational datasets, demonstrating that student behavior, when analyzed correctly, can forecast future outcomes. Their work laid the foundation for linking academic data with predictive models that assist educators in decision-making processes.

In the last decade, researchers have transitioned from simple statistical methods such as linear regression and correlation analysis to more sophisticated machine learning approaches. For example, Kotsianti et al. (2004) compared classification algorithms such as Decision Trees, Naive Bayes, and Support Vector Machines in predicting student grades, finding that ensemble methods often outperform traditional classifiers. These studies highlight the benefit of machine learning in handling complex and non-linear relationships within educational datasets. Recent literature reflects a noticeable shift toward deep learning and data-driven approaches. Deep neural networks, such as Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN), have been applied to sequential and behavioral data to capture temporal engagement patterns that traditional techniques cannot extract. Al-Balawi et al. (2018) successfully utilized recurrent neural networks to model student activity logs in online courses, showing significant improvement in prediction accuracy compared to baseline models.

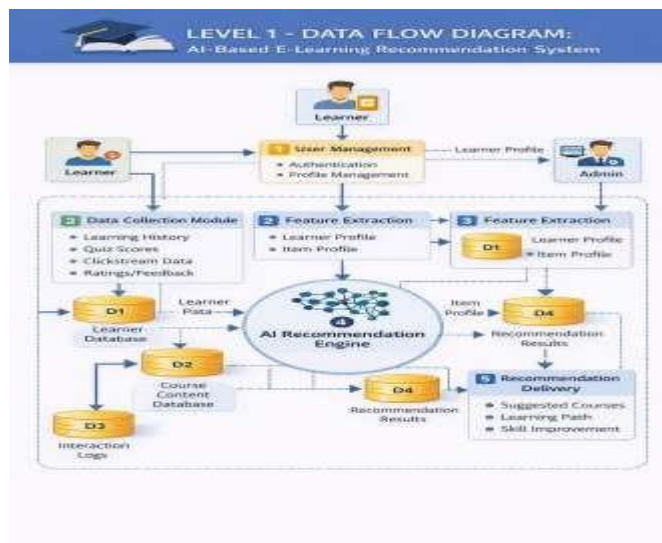


Fig -2: Data Flow Diagram

Several researchers have also emphasized feature engineering as a critical step in performance prediction. Student interaction logs, resource access patterns, time-on-task measurements, and forum participation metrics have been shown to contribute strongly to predictive accuracy. For example, Yang and Liu (2019) demonstrated that combining academic

scores with interaction data from LMS platforms significantly enhances the model's ability to detect early signs of student disengagement. The rapid development of digital education has led to the growth of various e-learning platforms. Traditional online learning systems mainly focus on delivering content through videos, notes, and quizzes. However, these systems provide uniform content to all learners without considering individual differences. Researchers have identified that lack of personalization reduces student engagement and learning effectiveness. Several studies have explored the use of Artificial Intelligence (AI) in education to improve personalization. AI-based learning systems analyze user behavior such as time spent on lessons, quiz performance, and course completion rates to understand learning patterns. Based on this analysis, recommendation systems suggest suitable learning materials to students. Research

Different recommendation techniques such as content-based filtering, collaborative filtering, and hybrid models have been widely studied. Content-based filtering recommends materials similar to those previously accessed by the learner. Collaborative filtering suggests content based on the behavior of similar users. Hybrid models combine both approaches to improve accuracy and effectiveness. Existing platforms like Coursera and Khan Academy use data-driven methods to enhance user experience, but many systems still lack fully adaptive and intelligent learning paths. Therefore, there is a need to design an advanced e-learning platform integrated with an AI recommendation engine that provides dynamic, real-time personalized suggestions. The proposed system aims to address these limitations by combining machine learning techniques with a structured e-learning environment to create a smarter and more adaptive digital education platform.

III. Proposed Methods

The proposed system is an intelligent E-Learning Platform integrated with an AI-based Recommendation Engine designed to provide personalized learning experiences to students. The main objective of this system is to analyze student behavior, performance, and interests to recommend suitable courses and learning materials. When a user registers on the platform, they provide details such as educational background, preferred subjects, skill level, and learning goals. This information is stored in a centralized database and forms the initial user profile. As the student interacts with the platform by enrolling in courses, attempting quizzes, watching video lectures, and completing assignments, the system continuously collects learning activity data such as time spent, scores obtained, course completion rate, and topic preferences. The collected data is processed through a feature extraction module where important attributes like average performance, weak subjects, and learning pace are identified. The AI recommendation engine then applies machine learning techniques such as Content-Based Filtering and Collaborative Filtering to generate personalized suggestions. Content-based filtering recommends courses similar to those previously studied by the learner, while collaborative filtering suggests courses preferred by other students with similar learning patterns. A hybrid approach combining both techniques ensures higher accuracy and relevance of recommendations.

The system architecture consists of a user interface layer, application layer, AI engine, and cloud database, which can be implemented using technologies such as Flutter or Android Studio for frontend development and Firebase for backend services. This proposed method enhances learning efficiency, improves course completion rates, reduces dropout chances, and creates an adaptive and scalable digital learning environment suitable for modern education systems.

CONCLUSIONS

The proposed **E-Learning Platform with an AI Recommendation Engine** provides an intelligent and personalized approach to digital education. Unlike traditional e-learning systems that offer the same content to all learners, the proposed system adapts to individual student needs by analyzing learning behavior, performance data, and interaction patterns. By integrating Artificial Intelligence and Machine Learning techniques, the platform can identify strengths and weaknesses, recommend suitable study materials, and generate adaptive learning paths. This improves student engagement, enhances learning efficiency, and supports self-paced education. The system also provides real-time feedback and detailed performance analysis, helping students track their progress and improve continuously.

Additionally, the platform assists faculty and administrators by providing analytical reports and monitoring tools that support better academic decision-making. The centralized dashboard ensures smooth communication and easy access to important information. Overall, the implementation of an AI-based recommendation engine in an e-learning platform creates a smarter, adaptive, and user-centric educational environment. The proposed system has the potential to improve academic performance, increase learner satisfaction, and contribute to the advancement of modern digital education systems.

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