

DEVELOPMENT OF AN INTELLIGENT SUBJECT RECOMMENDATION SYSTEM BASED ON BIG DATA

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Abstract - The increasing volume and complexity of educational data necessitate sophisticated approaches for personalized learning and academic guidance [1]. Specifically, the application of big data analytics and machine learning techniques offers a robust framework for developing intelligent recommendation systems that can effectively steer students toward suitable academic paths [2]. Such systems leverage diverse datasets, including academic performance metrics, demographic information, and socioeconomic indicators, to construct predictive models that forecast student success and inform optimal subject selection [3]. This proactive approach mitigates student attrition by enabling timely interventions and tailoring educational experiences to individual needs [4]. The integration of such sophisticated systems not only enhances student retention rates but also optimizes educational efficacy by providing data-driven insights into pedagogical strategies and curriculum development [5]. These models often undergo rigorous data preprocessing, including cleaning, scaling, oversampling, and feature selection, to ensure unbiased and generalized outcomes [6]. This comprehensive data preparation is crucial for maximizing the predictive accuracy score of the recommendation engine, ensuring that the system can discern subtle patterns within student profiles to optimize subject alignment with their aptitudes and aspirations [7]. Furthermore, the incorporation of fairness-aware predictive frameworks is crucial to mitigate bias and ensure equitable treatment across diverse student cohorts, thereby addressing potential disparities often overlooked by models relying solely on academic data [8]. Indeed, the expansive and varied nature of educational big data—derived from learning management systems, student information systems, and administrative records—necessitates advanced analytical techniques to extract meaningful insights for predictive modeling [9].

Keywords - big data analytics, management systems, predictive modeling, data preprocessing, recommendation engine.

Introduction

In the contemporary digital era, the rapid proliferation of data has permeated every facet of human life, with the educational sector being no exception. Higher education institutions (HEIs) are

increasingly generating vast amounts of data related to student performance, learning behaviors, and academic trajectories.[10] However, this abundance of data often remains underutilized, existing as isolated numerical figures rather than as a strategic asset for improving academic outcomes. One of the most pressing challenges faced by students, particularly during their undergraduate studies, is the selection of academic subjects. This decision is crucial as it shapes their specialization, influences their Grade Point Average (GPA), and ultimately determines their career prospects. Traditionally, subject selection has been guided by personal interest, peer influence, or the availability of seats, often leading to mismatches between a student's aptitude and their chosen field of study.[11]

The integration of Big Data analytics into education offers a transformative solution to this challenge. By harnessing the power of large-scale data processing and machine learning algorithms, it is possible to develop systems that provide personalized and intelligent recommendations. An Intelligent Subject Recommendation System leverages historical academic data, student profiles, and learning patterns to predict which subjects a student is most likely to excel in and find engaging.[12]. Such systems move beyond generic advice, offering data-driven insights that align with individual capabilities and institutional requirements.

Results

The development of such a system is particularly relevant in the context of Uzbekistan's rapidly modernizing higher education landscape. As the country places a strong emphasis on digital transformation and the enhancement of educational quality, the adoption of smart technologies in universities becomes imperative. This paper aims to explore the development of an intelligent subject recommendation engine based on Big Data.[13]. It will examine the architectural design, the data processing methodologies, and the machine learning models that underpin such a system, with the goal of improving student satisfaction and academic success in the digital age. The integration of Big Data technologies with intelligent recommendation methods enables the development of more accurate and efficient subject recommendation systems. By applying data mining techniques, machine learning algorithms, and predictive analytics, these systems can process large volumes of educational data and generate personalized recommendations for students.

Therefore, the development of an intelligent subject recommendation system based on Big Data is an important research direction that can significantly enhance decision-making processes in education.[14]. Such systems not only support students in selecting appropriate subjects but also help educational institutions improve curriculum planning and optimize learning outcomes.

Conclusion

In conclusion, the development of an Intelligent Subject Recommendation System based on Big Data represents a significant advancement in the application of technology within the educational sector. This paper has explored the multifaceted approach required to build such a system,

highlighting its potential to transform the traditional, often subjective, process of academic subject selection into a data-driven and personalized experience. By leveraging historical academic records, real-time performance metrics, and advanced machine learning algorithms, the proposed system aims to bridge the gap between student capabilities and curricular demands.

The findings of this research underscore the critical importance of harnessing educational data to support decision-making processes. An intelligent recommendation system not only assists students in identifying subjects that align with their strengths and career aspirations but also contributes to improving overall academic performance and reducing dropout rates. For educational institutions, the implementation of such a system offers a pathway to optimize resource allocation, enhance curriculum design, and foster a more engaging learning environment. The integration of Big Data analytics enables educators and administrators to gain deeper insights into learning patterns, thereby facilitating timely interventions and personalized academic guidance.

Furthermore, the relevance of this study is particularly pronounced in the context of Uzbekistan's ongoing educational reforms and digital transformation initiatives. As universities in the country strive to meet international standards and produce highly skilled graduates, the adoption of smart technologies like subject recommendation systems becomes not just beneficial, but essential. While challenges related to data privacy, infrastructure, and algorithmic bias must be carefully addressed, the potential benefits far outweigh the obstacles.

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