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# DEVELOPMENT OF AN AI-BASED INTELLIGENT RECOMMENDATION SYSTEM FOR DIGITAL LIBRARY PLATFORMS

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**Abstract** This scientific paper investigates the development and performance evaluation of an artificial intelligence-based intelligent recommendation system designed specifically for digital library platforms. Traditional library search engines often rely on basic keyword matching, which significantly limits user engagement and fails to deliver personalized content. To address this limitation, this study proposes a hybrid recommendation model that effectively integrates collaborative filtering and content-based filtering algorithms. The practical experiment conducted at the technical institute demonstrated that the AI-driven system substantially reduces content retrieval time, enhances user interaction metrics, and achieves exceptional recommendation precision compared to conventional methods.

**Keywords:** artificial intelligence, intelligent recommendation system, digital library, collaborative filtering, content-based filtering, personalization, user engagement.

**Annotatsiya** Ushbu ilmiy maqolada raqamli kutubxona platformalari uchun sun'iy intellektga asoslangan intellektual tavsiya tizimini ishlab chiqish va uning samaradorligini baholash masalalari tadqiq etilgan. An'anaviy kutubxona qidiruv tizimlari ko'pincha oddiy kalit so'zlarni moslashtirishga tayanadi, bu esa foydalanuvchilarning faolligini cheklaydi va shaxsiylashtirilgan kontentni taqdim eta olmaydi. Ushbu muammoni hal qilish uchun tadqiqotda kollaborativ va kontentga asoslangan filtrlash algoritmlarini integratsiyalashgan gibrid model taklif etilgan. Institutda o'tkazilgan amaliy eksperiment natijalari shuni ko'rsatdiki, SI asosidagi tizim kontentni qidirish vaqtini sezilarli darajada qisqartiradi va tavsiya aniqligini oshiradi.

**Kalit so'zlar:** sun'iy intellekt, intellektual tavsiya tizimi, raqamli kutubxona, kollaborativ filtrlash, kontentga asoslangan filtrlash, shaxsiylashtirish.

**Аннотация** В данной научной статье исследуются вопросы разработки и оценки эффективности интеллектуальной рекомендательной системы на основе искусственного интеллекта для платформ цифровых библиотек. Традиционные поисковые системы библиотек часто полагаются на простое сопоставление ключевых слов, что ограничивает вовлеченность пользователей и не обеспечивает персонализацию контента. Для решения этой проблемы в исследовании предложена гибридная модель, интегрирующая методы коллаборативной и контентной фильтрации. Результаты практического эксперимента в технологическом институте показали, что система на основе ИИ значительно сокращает время поиска контента и повышает точность рекомендаций по сравнению с традиционными методами.

**INTRODUCTION** In the contemporary era of global digitalization, academic and public library infrastructures have fundamentally transitioned from physical repositories to expansive digital library platforms. These modern platforms host millions of scientific papers, textbooks, and multi-format educational resources. However, this massive influx of information has triggered a severe state of information overload for university students and researchers alike [1, P. 112].

Conventional digital library search engines predominantly rely on static keyword matching, which frequently yields irrelevant results and completely fails to accommodate the implicit, shifting interests or distinct academic backgrounds of individual users [3, P. 25].

The strategic application of artificial intelligence (AI) and machine learning (ML) algorithms presents an innovative solution to this structural bottleneck through advanced recommendation systems. By seamlessly analyzing historical user interactions, search logs, and document semantics, an AI-based system can dynamically predict and present highly relevant scientific literature to readers. The scientific urgency of this research lies in the critical need to automate content curation within institutional digital libraries, eliminate navigation inefficiencies, and build an automated framework that actively supports customized academic trajectories.

**MATERIALS AND METHODS** The practical object of this comprehensive research focuses on the optimization of the digital library repository interface and the tracking of academic resource consumption patterns at the Andijan State Technological Institute. To architect a robust and resilient intelligent recommendation framework, a specialized hybrid methodology was formulated and mathematically defined as follows:

1. **Content-Based Filtering Matrix:** The semantic profiles of documents are structurally mapped by executing the Term Frequency-Inverse Document Frequency (TF-IDF) algorithm. The exact cosine similarity score (Sim(u, v)) between a user's historical preference vector ($\vec{u}$) and a newly uploaded target item vector ($\vec{v}$)is calculated using the following unalterable mathematical equation:

$$Sim(u,v)=\frac{\vec{u}\cdot\vec{v}}{\|\vec{u}\|\|\vec{v}\|}=\frac{\sum_{i=1}^{n}u_i v_i}{\sqrt{\sum_{i=1}^{n}u_i^2}\sqrt{\sum_{i=1}^{n}v_i^2}}$$

Where $u_i$ and $v_i$strictly represent the localized feature weights within the multi-dimensional vectors.

2. **Collaborative Filtering via Matrix Factorization:** Singular Value Decomposition (SVD) was systematically utilized to uncover latent interactive dependencies between users and research topics based on historical rating matrices [5, P. 201].

An empirical validation experiment was carefully executed over a twelve-week period, involving a sample size of 120 undergraduate researchers. The participants were equally distributed into a baseline control group (accessing a standard keyword-based search interface) and an active experimental group (utilizing the newly developed hybrid AI recommendation platform).

**LITERATURE REVIEW** Over the past 10 to 15 years, international scholarly literature has dedicated substantial attention to the architecture of AI-powered recommendation systems within academic settings. Globally recognized institutional systems like Mendeley Suggest and Google Scholar Recommendations have effectively proven that personalized algorithms radically accelerate the literature review process for scientists [5, P. 210]. Yesilyurt (2023) analytically established that un-optimized, static digital archives cause a notable 30% drop in student digital library retention due to cognitive navigation fatigue [3, P. 30]. Concurrently, Alimov (2026) verified that real-time contextual filtering significantly enhances digital platform utility by adapting to immediate research shifts [1, P. 115].

Within the Republic of Uzbekistan, the scientific implementation of machine learning within library networks represents an emerging domain. Tojiyev (2025) highlighted the structural necessity of adopting real-time data analytical tools to carefully evaluate university library resource utilization metrics [4, P. 48]. Nevertheless, local investigations heavily prioritize generalized cloud storage logistics, leaving the development of specific Uzbek-language semantic extraction models and adaptive hybrid algorithms for institutional library engines largely unaddressed. This visible gap directly confirms the necessity of this current research.

**RESULTS AND DISCUSSION** During the course of the study, a fully functional web-based software prototype of the intelligent recommendation system was developed and successfully deployed within the local intranet of the Andijan State Technological Institute.

The underlying algorithm executes in a structured sequence: upon initial login, the platform processes the user's academic department data. As the user reads papers, the TF-IDF engine dynamically updates their personal vector. The system then merges collaborative filtering clusters with content similarity calculations to actively recommend a customized "Top-5 Reading List" on the user's dashboard.

The comprehensive statistical data gathered during the practical trial was systematically structured and compared against the baseline system (Table 1).

*Table 1. Technical and user performance metrics of the evaluated library platforms*

| **Performance Evaluation Parameters** | **Traditional Library Search** | **AI-Based Hybrid System** |
|---|---|---|
| Average content discovery time (minutes) | 14.5 min | 4.2 min |
| Recommendation Precision Rate (P@5) | 0.42 | 0.88 |
| Mean User Click-Through Rate (CTR) | 12.4% | 41.6% |
| Overall platform user satisfaction index | 54% | 89% |
| System computation response latency | Variable | Real-time (<0.3s) |

An analysis of the empirical results distinctly reveals that the AI-driven hybrid system dramatically minimizes the time required for students to discover relevant academic literature, dropping from 14.5 minutes down to just 4.2 minutes. Furthermore, the precision of the

recommendations (P@5) experienced an outstanding increase, climbing from a low 0.42 up to an accurate 0.88.

This major technical improvement occurs because the hybrid algorithm efficiently filters out irrelevant search noise and concentrates on matching the underlying mathematical semantics of the texts [6, P. 92]. The system automatically generates a visual research-interest cloud for university administrators, enabling them to make precise, data-driven decisions regarding future textbook acquisitions [8, P. 14].

**CONCLUSION** The empirical findings and algorithmic performance metrics verified throughout this research conclusively demonstrate that integrating an AI-based intelligent recommendation system into digital library platforms successfully resolves the chronic issues of information overload and poor search precision. The engineered hybrid model effectively reduces cognitive searching stress for students while systematically increasing the accessibility of digital academic content. Consequently, this platform serves as an advanced computational tool to automate educational data monitoring and fully optimize independent student research workflows in higher education institutions.

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