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## **PERSONALIZED MUSIC RECOMMENDATIONS BASED ON USER BEHAVIOR ANALYTICS**

The exponential growth of digital music platforms has created a vast and diverse content library, making personalized discovery of music tracks increasingly important for user satisfaction and engagement. Users often face difficulties in finding relevant content, while creators struggle to promote their works efficiently. Intelligent recommendation systems provide a solution by predicting user preferences based on behavioural data [1].

Early recommendation methods, including popularity-based and simple rule-based filtering, often failed to account for complex user preferences, while collaborative and content-based approaches were limited by cold-start issues and sparse datasets [2].

This study investigates a hybrid recommendation framework for a digital music platform, integrating user behavioral analytics with machine learning techniques. The system collects interaction data, including play events, likes, playlist additions, and purchase history, to model user preferences. Various strategies are evaluated, such as user-based collaborative filtering, item-based similarity models, and hybrid approaches that combine behavioral signals with content metadata, including genre, tempo, and mood [3].

In addition, transformer-based language models and large language models (LLMs) are employed to analyze textual metadata and automatically enrich music tags, enhancing the quality and relevance of recommendations [4]. This feature enables better understanding of content semantics and allows the system to recommend tracks even for newly uploaded music with limited user interactions.

Additionally, the proposed framework emphasizes the commercialization aspect of digital music platforms by integrating seamless mechanisms for music sales and monetization. By analyzing user preferences and engagement patterns, the system not only recommends relevant tracks but also identifies high-potential content for promotion and targeted marketing. This approach supports independent creators in reaching their audience more effectively while maximizing platform revenue. The integration of recommendation algorithms with transactional features, such as direct purchase links and subscription-based access, creates a unified ecosystem where user satisfaction, content discoverability, and economic incentives are aligned. This commercial perspective complements the

technical improvements in hybrid recommendation strategies, ensuring practical applicability in real-world digital music marketplaces

Experimental evaluation uses offline metrics, including Precision@K, Recall@K, and F1-score, alongside online business-oriented indicators, such as click-through rate and conversion to purchase [5]. Results indicate that hybrid models outperform baseline popularity-based approaches, achieving improvements of up to 15-25% across key metrics. LLM-assisted feature extraction further improves recommendation relevance, particularly for new or less-interacted content. These results demonstrate the practical applicability of combining behavioral and semantic data in real-world digital music platforms.

The proposed framework contributes to the development of adaptive digital music platforms by improving user engagement, satisfaction, and content monetization. These findings provide a foundation for further research in personalized content delivery, AI-driven creative tools, and large-scale recommendation systems. Future research directions include the integration of real-time learning mechanisms, reinforcement learning for dynamic recommendation optimization, and multimodal analysis combining audio signals with behavioral and textual data. The integration of user feedback loops can also enhance model accuracy over time and support personalized experiences at scale.

### References:

1. Ricci F., Rokach L., Shapira B. Recommender Systems Handbook. 2nd ed. Springer. 2015. Pp. 1-1000. DOI: <https://link.springer.com/book/10.1007/978-1-4899-7637-6>.
2. Aggarwal C.C. Recommender Systems: The Textbook. Springer. 2016. Pp. 1-400. URL: <https://link.springer.com/book/10.1007/978-3-319-29659-3>.
3. He X., Liao L., Zhang H., Nie L., Hu X., Chua T.-S. Neural Collaborative Filtering // Proc. 26th Int. Conf. on World Wide Web (WWW '17). 2017. Pp. 173-182. URL: <https://dl.acm.org/doi/10.1145/3038912.3052569>.
4. Devlin J., Chang M.-W., Lee K., Toutanova K. BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding. NAACL-HLT. 2019. Pp. 4171-4186. URL: <https://arxiv.org/abs/1810.04805>.
5. Zhang L., et al. Enhancing music recommendation systems with hybrid ML models and LLM-assisted feature extraction. Journal of AI in Music Technology. 2025. Pp. 12-28. URL: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0334120>.