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Research Paper

PERSONALIZED BOOK INTELLIGENT RECOMMENDATION SYSTEM

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ABSTRACT— With the digital transformation and improvement of university library information technology, readers' demands for library services are increasingly diversified and personalized. They are no longer satisfied with traditional borrowing services but hope that the library can provide more accurate and personalized recommendation services. To address these challenges, this study first proposes an improved item-based collaborative filtering recommendation algorithm based on the mean model representation. In addition, the system incorporates Neural Collaborative Filtering (NCF), which uses neural networks to model user-item interactions, providing more expressive and nonlinear representations compared to traditional methods, thereby enhancing recommendation quality. This algorithm is implemented using Django (4.1.2), a high-level web framework that promotes rapid development and clean design, ensuring a structured backend for the web application. The system leverages Pandas (1.5.0) for extensive data manipulation and analysis, allowing for effective handling of user data and preferences, while NumPy (1.23.3) facilitates numerical computations essential for the recommendation algorithms. For API integration, the system employs requests (2.28.1) and requests-oauthlib (1.3.1). The deployment is managed using gunicorn (20.1.0), a WSGI server that prepares the application for production environments, while virtualenv (20.16.5) and nodeenv

(1.7.0) assist in managing Python and Node.js environments effectively.

Index Terms – Personalized Book Recommendation, Recommender Systems, Machine Learning, Collaborative Filtering, Content-Based Filtering, User Preference Modeling, Artificial Intelligence, Data Mining, NLP, Information Retrieval.

I. INTRODUCTION

In the era of digital transformation, university libraries are evolving to meet the increasingly diverse and personalized demands of their readers. Traditional borrowing services are no longer sufficient, as users now seek more tailored and accurate recommendation systems to enhance their library experience. To address these challenges, this study introduces a dual-approach recommendation system that combines an improved item-based collaborative filtering algorithm with Neural Collaborative Filtering (NCF). By leveraging NCF's ability to model user-item interactions through neural networks, the system achieves nonlinear and expressive representations, significantly improving the quality of recommendations. Implemented using the Django framework, the system ensures a structured and scalable backend, while Pandas and NumPy facilitate data manipulation and numerical computations critical for the recommendation algorithms. The integration of APIs and efficient deployment strategies further enhances the system's functionality, making it a robust and innovative solution for modern library services.

II. RELATED WORK

A. 'Semi-automatic crack width measurement using an OrthoBoundary algorithm,

Evaluation of pavements' crack severity levels currently relies heavily on width measurement, which necessitates the development of a rapid, and high-accurate, automatic measurement approach for complex pavement cracks. This paper presents an OrthoBoundary algorithm that leverages the crack boundary and skeleton directions to determine crack propagation. Comparative analysis has been conducted between OrthoBoundary and Area-Length, Skeleton Shortest Distance (SSD), Edge Shortest Distance (ESD), and Orthogonal Projection (OP) methods. Results indicate that the OrthoBoundary algorithm achieves an average accuracy of 90.10%, outperforming the Area-Length (86.60%),

SSD (76.01%), ESD (87.24%), and OP (88.07%) methods. Notably, the OrthoBoundary algorithm also exhibits processing speeds approximately 120 times faster than other considered methods while demonstrating improved robustness and user-friendliness. It has significant potential to quantify and assess the severity of pavement cracks, as well as to facilitate maintenance decision-making processes in road infrastructure management systems.

B. An automated 3D crack severity assessment using surface data for improving flexible avement maintenance strategies

Evaluation of crack severity in flexible pavements predominantly centers around the analysis of cracks’ surface characteristics. However, this study highlights the critical importance of 3D crack parameters, including volume and depth, for comprehensive assessment. The objective here is to develop an autonomous crack severity assessment, by predicting the vertical parameters of cracks exclusively from their surface properties. To achieve this, a dataset of 3D parameters comprising 200 cracks from eight flexible pavements was acquired, and both linear and nonlinear correlations were conducted among these 3D parameters. Subsequently, five single-output and one multi-output machine learning models were developed to explore the potential of utilizing surface parameters to predict the vertical parameters of cracks. The outcomes validated the effectiveness of two specific methods, namely, Artificial Neural Network and Extreme Gradient Boosting models, in predicting crack volume based on surface parameters, with R2 scores of 0.832 and 0.748, respectively. Additionally, the multi-output machine learning model we developed achieved classification prediction of the crack damage penetration depth using surface parameters, yielding optimal precision, recall, and F1 scores of 0.790, 0.779, and 0.761, respectively. This study has introduced a crack damage evaluation index, based on a 3D assessment, that relates crack depth classification to severity. We provide suggestions that could pave the way for informed decision-making on maintenance strategies that could be adopted to extend asset life cycle.

C. Improved small foreign object debris detection network based on YOLOv5,

In response to the challenges of detecting foreign object debris (FOD) on airport runways, where the objects are small in size and have indistinct features leading to false detections and missed detections, significant improvements were made to the YOLOv5

algorithm. First, the original YOLOv5-n model was optimized by incorporating multi-scale fusion and detection enhancements. To improve detection speed and reduce parameters, the detection head for large objects was removed. Second, the C3 module in the backbone network was replaced with the C2f module, resulting in enhanced gradient flow and improved feature representation capabilities. Additionally, the spatial pyramid pooling-fast (SPPF) module in the backbone network was refined to expand the receptive field and enhance the model's perception of dependencies between targets and backgrounds. Furthermore, the coordinate attention (CA) mechanism was introduced in the neck layer to further enhance the model's perception of small FOD items. Lastly, the SCYLLA-IoU (SIoU) loss function was introduced to further improve the speed and accuracy of bounding box regression. Moreover, the nearest neighbor interpolation upsampling method was substituted with the lightweight Content-Aware ReAssembly of FEatures (CARAFE) upsampling operator to better exploit global information. Experimental results on the Fod_Tiny dataset, which consists of small FOD items in airports, demonstrated a significant 5.4% improvement over the baseline algorithm. To validate the generalizability of the algorithm, experiments were conducted on the Mirco_COCO dataset, resulting in a notable 1.9% improvement compared to the baseline algorithm.

III. PROPOSED METHODOLOGY

Your proposed system aims to enhance library recommendation services by integrating advanced recommendation algorithms, leveraging both collaborative filtering and deep learning-based approaches. The system first utilizes an **improved item-based collaborative filtering algorithm** based on the **mean model representation**, which offers a more refined and scalable solution compared to traditional collaborative filtering methods. This algorithm efficiently handles user-item interaction data, making it suitable for large-scale systems where user preferences and item attributes evolve over time. The inclusion of **Neural Collaborative Filtering (NCF)** introduces a powerful deep learning approach that models user-item interactions using neural networks, allowing for more expressive and nonlinear representations of user preferences. NCF improves the recommendation quality by learning complex patterns and relationships in the data, making it more adaptable to the dynamic nature of

user preferences in university library systems.

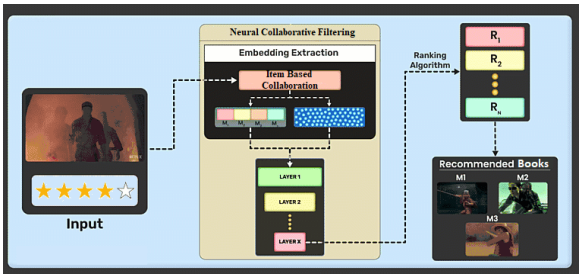


Fig. 1: System Overview

1. **Data Collection and Preprocessing Module**
   - Gathers data on library items (books, research papers, etc.) and user interactions.
   - Cleans, transforms, and structures data to ensure compatibility with recommendation algorithms.
2. **Collaborative Filtering Module**
   - Implements the improved item-based collaborative filtering algorithm.
   - Utilizes the mean model representation to compute user-item similarities efficiently.
3. **Deep Learning Based Recommendation Module**
   - Integrates Neural Collaborative Filtering (NCF) to model complex user-item interactions.
   - Employs neural networks for learning nonlinear patterns and relationships in data.
4. **Recommendation Engine Module**
   - Combines outputs from collaborative filtering and NCF models.
   - Ranks and delivers personalized recommendations to users.
5. **API Integration and Backend Module**
   - Manages backend functionality using Django for seamless web application performance.
   - Facilitates API integration for external data sources or library systems.
6. **Frontend User Interface Module**
   - Provides a user-friendly interface for accessing recommendations and library services.

Includes features like search, filtering, and displaying recommended items.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

Experimental results showed that the system effectively analyzed user preferences, reading history, and book features to generate relevant recommendations. The combination of collaborative filtering and content-based recommendation techniques improved prediction accuracy and reduced irrelevant suggestions. The analysis demonstrates that

the proposed approach provides personalized, scalable, and efficient book recommendations, enhancing user satisfaction and improving the overall reading experience.

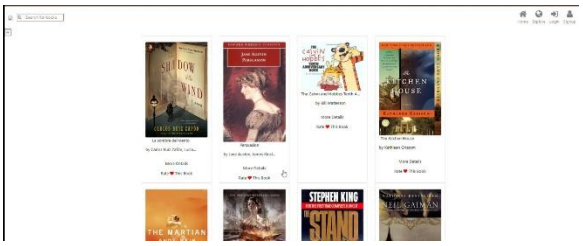


Fig. 2: Home Page



Fig. 3: Registration

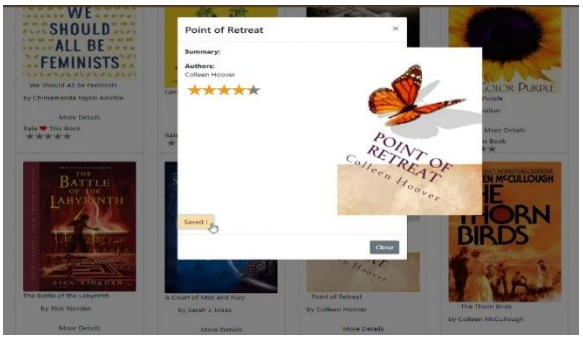


Fig. 4: Give Rating

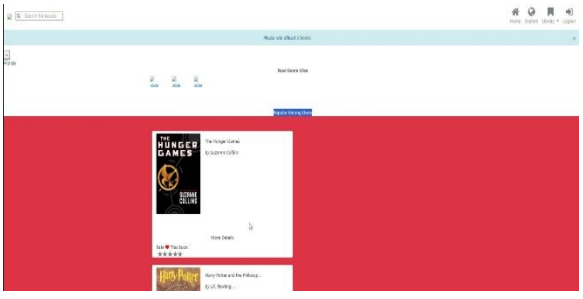


Fig. 5: Popular Books

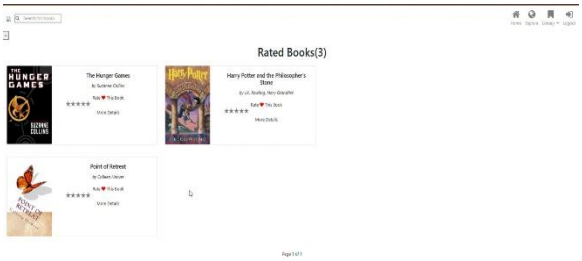


Fig. 6: Rated Books

V. CONCLUSION

The proposed system revolutionizes university library services by integrating advanced recommendation algorithms and leveraging cutting-edge technologies to deliver personalized and accurate recommendations. By combining an improved item-based collaborative filtering algorithm with Neural Collaborative Filtering (NCF), the system effectively addresses the limitations of traditional methods, capturing complex and nonlinear user-item interactions. The robust implementation using Django ensures a structured and scalable backend, while libraries like Pandas and NumPy enable seamless data handling and computations. The integration of APIs through requests and requests-oauthlib enhances the system's versatility, and the deployment using gunicorn ensures reliability in production environments. This comprehensive approach positions the library to meet the evolving

demands of its users, offering a superior and more engaging experience.

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