Research on Network Platform System Under Mobile Internet and Smart Electronic Commerce Big Data Digitization

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Abstract. Based on the intelligent big data method and the cross-border e-commerce logistics service system as the research object, the paper constructs a cross-border e-commerce logistics service system based on mobile Internet. According to the user's preference, the products matching the user's preference are obtained through association rule mining, and recommended to the user. The research shows that the digital cross-border e-commerce platform system involved in the paper has good compatibility, and the user preference recommendation algorithm involved in the paper has high accuracy, which meets the needs of users.

Keywords: Cross-border e-commerce platform, intelligent algorithm, internet big data.

1. Introduction
In the past few years, China’s foreign trade volume enhancement rate has not been high, but due to the huge economic volume, the total volume of foreign trade is still considerable. In the huge wave of foreign trade in the era of big data, the development of e-commerce has gradually developed in accordance with the trend. The role of statistics and interaction in the era of big data has been indispensable in today's world business [1]. The statistics and use of e-commerce are a fortress that e-commerce must focus on in the new era, and make full use of the value and potential resources of big data to improve the efficiency of e-commerce economic activities. In this regard, this article studies and designs a cross-border e-commerce website system to provide convenient services for cross-border transactions.

2. System requirement analysis
2.1. Functional requirements
Among the functional requirements, the cross-border e-commerce website design includes the front-end service and back-end products, and the management of customer accounts, so it includes the front-end system functional requirements and the back-end system functional requirements.

2.1.1. The functional requirements of the foreground system. (1) Login function: The front-end mall can register and log in. (2) Search function: can search for products. (3) Personal Centre: The user enters the Personal Centre to view and modify personal information, view historical orders, logistics information, etc. (4) Shopping function: add the product to the shopping cart, enter the settlement page, select the receiving and payment method, and confirm the order.
2.1.2. Back-end system functional requirements. (1) Commodity management: including commodity classification, commodity specifications, adding and editing commodity information, and managing commodities on and off shelves. (2) Content management: including the editing of advertisements and the modification of website articles. (3) Order management: including querying orders, processing orders, being able to deliver goods, and filling in logistics information. (4) Logistics management: add logistics companies and modify supported logistics companies. (5) Payment Management: Add and modify the supported payment methods. (6) Statistical analysis: statistical sales data, commodity data, etc. (7) Account management.

2.2. Non-functional requirements
(1) Performance requirements: The system must be usable, the normal running time must be reasonable, and it can be used 24 hours a day. At the same time, the throughput of the system must meet the demand. During the peak period of access and concurrency, it must be able to meet the demand by adding servers. (2) Security requirements: Both the front-end mall and back-end management systems require login permissions. The back-end system can only be operated after logging in to the system, otherwise the system page cannot be accessed.

3. Introduction and application of cross-border e-commerce user preference recommendation algorithm

3.1. Recommendations based on collaborative filtering
The main method of user-based CF (UCF) is to find a group of users with similar hobbies, that is, user-based CF or neighbour-based CF. The similarity between users is usually calculated by Jaccard formula or cosine similarity [2]. In this case, the similarity between two users can be observed more intuitively. Suppose \( M(u) \) is the set of favourite items of user \( u \), and \( M(v) \) is the set of favourite items of user \( v \), then the formula for calculating the similarity between \( u \) and \( v \) is:

Cosine similarity:

\[
w_{uv} = \frac{|M(u) \cap M(v)|}{\sqrt{|M(u)| \times |M(v)|}}
\]  

(1)

Jaccard formula:

\[
w_{uv} = \frac{|M(u) \cap M(v)|}{|M(u) \cup M(v)|}
\]  

(2)

The specific method of UCF is to understand the user's project preferences by collecting information about the user. Then, a group of users like the user is found by calculating the similarity between the users, and the preference record information of this group of users is used to predict the user's rating of related items [3]. As the number of users increases, UCF consumes more and more computing time. In 2001, another CF appeared, namely item-based collaborative filtering algorithm. The basic assumption of ICF is that if a user likes an item, other items like the item may also arouse the user's interest. The similarity between items is calculated mathematically. The calculation formula for the similarity of items is:

\[
w_{ij} = \frac{|M(i) \cap M(j)|}{\sqrt{|M(i)| \times |M(j)|}}
\]  

(3)
Among them, \(|M(i)|\) is the number of users who like item i, and \(|M(j)|\) is the number of users who like item j. The method steps of ICF are as follows: collect corresponding information, calculate the similarity between the evaluated item and the predicted item, and obtain the predicted score of the predicted item based on this, and finally produce the recommended result.

3.2. Hierarchical POI recommendation algorithm HMF-G

In this article, I chose non-negative matrix factorization (NMF) as the basic model of the proposed algorithm. In Nature magazine in 1999, Lee and Seuang proposed a new method of matrix factorization [4]. This MF is a non-negative matrix factorization. The components decomposed by this method are all non-negative values, and at the same time, nonlinear dimensionality reduction is achieved. NMF decomposes the score matrix into two non-negative low-rank matrices \(U \in \mathbb{R}^{n \times d}\) and \(V \in \mathbb{R}^{d \times m}\), where \(U\) is the user preference matrix and \(U(i,:)\) is the preference vector of ui. \(V\) is the POI feature matrix, and \(V(:,j)\) is the feature vector of \(vj\). Through NMF, the score \(X(i,j) = U(i,:)V(:,j)\) of \(vj\) by \(ui\) can be obtained. \(U\) and \(V\) can learn by solving the following optimization problems:

\[
\min_{U \geq 0, V \geq 0} \|W \odot (X - UV)\|_F^2 + \beta(\|U\|_F^2 + \|V\|_F^2)
\]

(4)

Which represents the Hadamard product, \(W(i,j)\) controls the contribution of \(X(i,j)\) to the learning process. If \(ui\) scores \(vj\), then \(W(i,j) = 1\), otherwise \(W(i,j) = 0\). We get the hierarchical structure shown in Figure 1.

![Figure 1. Deep decomposition of the POI feature matrix](image)

Through mathematical modelling of multi-layer hierarchical structure, HMF-G needs to solve the following optimization problems.

\[
\min_{U_1,...,U_p,V_1,...,V_q} \|W \odot (X - U_1...U_pV_1...V_q)\|_F^2 + \lambda(\sum_{j=1}^{p}\|U_j\|_F^2 + \sum_{j=1}^{q}\|V_j\|_F^2)
\]

s.t. \(U_j \geq 0, i \in \{1,2,...,p\}, V_j \geq 0, j \in \{1,2,...,q\}\)

(5)

4. System Design

4.1. Overall structure

The cross-border e-commerce platform architecture and the J2EE architecture correspond to each other, and they are both built based on a componentized multi-layer model. The content of application system 1 and application system 2 are different. Application system 1 refers to the original application system of the enterprise, and application system 2 refers to the application system that may be added or newly added in the future. If it is possible to add business contracts in the future System, charging
system, equipment system, etc. Moreover, the collection and transmission of information belong to two different components, which are built on two different application system interfaces. The collection and transmission of information data must be transmitted to the message centre queue in the form of files in accordance with the implementation-defined information format, and then the message centre will distribute it to each corresponding application system message queue in accordance with the rules. Among them, the receiving and consuming component keeps monitoring. Once it receives the information sent by the message centre to the application system, it quickly analyses the message, and quickly extracts the effective data information, and implements it according to the content of the rule library. Information processing. The system is divided into the foreground and the background [5]. The foreground and the background can be separately deployed on the server. This design is conducive to adding servers reasonably. The front and back ends are all B/S structures. For a mall system, this is more practical and simpler to operate. Development is also relatively simple. For a good mall, the front-end mall system should be divided into multiple terminals, and the design includes WeChat mall, mobile web terminal, and mobile app mall as shown in picture 2.

![System architecture of cross-border e-commerce platform](image)

**Figure 2.** System architecture of cross-border e-commerce platform

4.2. **System topology design**

In the process of users visiting the website, under the premise of multiple servers, reasonable measures should be taken to ensure that the load of the front-end mall can be balanced. When the pressure on the front-end mall server is too high, it can be properly handled by adding the number of servers appropriately, without adjusting the back-end. Mainly because the pressure in the background is generally not too large, so there is no need to add servers. But for data servers, the pressure is usually greater, but it must be correctly recognized that the more the number of corresponding servers, the higher the cost. In this regard, the flexible reference of caching technology can help the database to reduce the pressure as much as possible [6]. The system design usually has Redis. If necessary, the Redis cache can be added to help the database to effectively relieve the pressure. In the case of high concurrency, the server pressure can be relieved as much as possible by appropriately increasing the
deployment. The topological structure of the website is shown in Figure 3, with a database server and a picture server. When a user visits a website, if there are multiple servers, nginx is needed to achieve load balancing of the front-end mall. When the pressure on the front-end mall server is high, you can simply add the number of servers, and there is no need to change the back-end. Generally, the background pressure is not too great, so there is generally no need to add a server.

![Figure 3. The system topology of the cross-border e-commerce platform](image)

5. System implementation and testing based on intelligent big data recommendation algorithm
The experiment uses the data set in the artificial intelligence cross-border e-commerce shopping guide platform with many purchase records to conduct the experiment. First, the data is reprocessed, and users are grouped according to purchase records to obtain records for each user's own purchase. Delete users whose purchase history is less than 100 times, and delete products that have been purchased less than 60 times. After the data pre-processing is completed, the user-commodity matrix is established. If a product is purchased by the user, the corresponding matrix element is 1. The specific data is shown in Table 1.

| Data set      | Number of users | Amount of goods | Purchase History |
|---------------|-----------------|-----------------|------------------|
| Whole data set| 39025           | 21359           | 6523855          |
| Training set  | 27318           | 14,951          | 4566699          |
| Test set      | 11708           | 6408            | 1957157          |

The proposed algorithm recommends the best click-through rate of product information, indicating that the proposed algorithm recommendation results are more in line with user needs. The conversion rate of the algorithm in this paper is also the highest among all algorithms, indicating that its recommended product information meets user preferences, can be better converted into purchase behaviour, and has strong applicability.

6. Conclusion
This research designed a cross-border e-commerce service system based on mobile Internet. The system realizes functions such as product management, content management, order management, user management, logistics management, payment management, statistical analysis, product search, and user shopping. Shopping provides a convenient platform. The research shows that the digital cross-border e-commerce platform system involved in the paper has good compatibility, and the user
preference recommendation algorithm involved in the paper has high accuracy, which meets the needs of users.

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