Hindawi
Mobile Information Systems
Volume 2022, Article ID 1761579, 11 pages
https://doi.org/10.1155/2022/1761579

Research Article

e-Commerce Personalized Recommendation Based on Machine Learning Technology

Liping Liu

School of Management, Wuhan College, Wuhan, 430212 Hubei, China

Correspondence should be addressed to Liping Liu; 9233@whxy.edu.cn

Received 21 February 2022; Revised 12 March 2022; Accepted 21 March 2022; Published 25 April 2022

Academic Editor: Chia-Huei Wu

As e-commerce offers more and more choices for users, its structure becomes more and more complicated. Inevitably, it brings about the problem of information overload. The solution to this problem is an e-commerce personalized recommendation system using machine learning technology. People often seem confused when facing extensive information and cannot grasp the key points. This paper studies the personalized recommendation technology of e-commerce: deeply analyzes the related technologies and algorithms of the e-commerce recommendation system and proposes the latest architecture of the e-commerce recommendation system according to the current development status of the e-commerce recommendation system. The system recommends accuracy and real-time requirements and divides the system into two parts: offline mining and online recommendation and analyzes and implements the functions and technologies of each part. User-based recommender systems, collaborative filtering recommender systems, and content-based recommender systems are analyzed, respectively. The personalized recommendation cannot only quickly help customers find the required commodity information in a wide range of complex information but also can compare more commodity information to help customers to judge. However, the existing recommendation system has some problems such as the lack of recommendation personality, the reduced relevance of recommendation, and the poor timeliness of recommendation. Finally, a recommendation system that combines three recommendation algorithms is designed, and experiments are carried out. The newly designed recommendation system is compared with three different recommendation systems, and a summary and outlook are made. Based on the introduction of the relevant theories, characteristics, and mainstream technologies of personalized recommendation based on machine learning, this document presents a constructive example of a model based on the factors that influence personalized e-commerce information recommendations in the retail sector. Through questionnaire surveys, we analyze and design the influencing factors for consumers to purchase personalized products after the survey and build a project using state-of-the-art field learning techniques. Through the model to test the eight hypotheses proposed in this paper, the results show that customer income level, customer online shopping experience, commodity prices, product quality, recommendation relevance, credit evaluation, and service quality will have a significant positive impact on shopping willingness and ultimately affect the customer's shopping behavior. e-commerce platform can use this influencing factor to establish personalized information recommendation service mode.

1. Introduction

e-commerce has been growing at a very fast pace in recent years and has a bright future. Among them, e-commerce platforms are growing at the fastest rate, up by more than 40% year-on-year.

e-commerce has gone through different periods: firstly, there was the period based on users, when e-commerce platforms made profits from users by establishing membership systems and then came the volume-based period. Finally, there was the data-based phase. As technology continues to upgrade, the number of websites offering e-commerce and the number of products on e-commerce sites has grown exponentially. Faced with such a significant amount of commodity information, how to quickly and easily obtain the product information of interest to users has become a practical problem, and this problem is also called the "information overload" problem. As the technology has

matured, referral services have emerged as a necessary tool for personalized information requests in e-commerce. The e-commerce personalized recommendation service is mainly divided into personalized service content and personalized service mode.

1.1. Personalized Service Content. Each user's demand for information and services varies according to their conditions, and the service users of personalized information are not merely accepted. e-commerce companies can provide users with a wide range of choices, and more importantly, they can recommend product information that meets their purchasing habits according to their needs, thereby shortening the time it takes for users to search for products that meet their requirements. Not only that, enterprises can use the user's personalized information recommendation service based on the user's preference for information and provide users with services that meet their personalized information needs. The study of users' information use habits can better provide users with the information resources that meet the requirements. It is beneficial to the development of the data in the process of the development of the personalized information service in the process of online shopping, and it can be applied to the process of commodity promotion to provide a better response to the individual requirements of the user. Personalized marketing is a highly respected marketing method in corporate marketing, because compared with traditional marketing methods, personalized marketing is more targeted; that is, it can carry out one-to-one marketing according to individual differences and individual needs of users. User recommendation system is an indispensable marketing tool for personalized marketing.

1.2. Personalized Service Mode. The information provider directly publishes the information to the Internet, and the user can find the corresponding information on the Internet according to his own needs. This service mode will spend a lot of time and effort on the conversion between web pages. The other way is that the information provider sends the latest update information to the user in the form of a summary, and the user can screen the information pushed by the user according to its own needs. The advantage is that it can save a lot of users' time so that users cannot waste too much energy in the search process. In recent years, with the increasing number of online transactions and more and more complex business information, it is really difficult for customers to find satisfactory products from a large number of words and pictures. However, if the website provides a reasonable recommendation or prompt for the user at this moment, it can help the user to complete the shopping activity smoothly, thereby reducing network congestion.

The platform can comprehensively analyze users' purchase intentions and buying behavior, provide customized services for users, and increase the turnover of the website through such personalized services. In this paper, the relevant theoretical knowledge involved is systematically introduced, including the concept, characteristics, and leading technologies of the theory. Moreover, on this basis, the model of the influencing factors of personalized information recommendation in e-commerce is built. Through the analysis and design of the influencing factors of consumers' purchase of personalized goods, the proposed model is tested and revised, and personalized information recommendation service model is established. But at present in various fields, there are still great problems in the research of recommender system, which is due to the difficulty of the problem itself. Although researchers continue to achieve results in the study of personalized recommendation systems, the recommended algorithms designed have more or less limitations. And this kind of e-commerce personalized recommendation system based on data mining can not only effectively solve the problem of huge and cluttered information in the recommendation system but also realize the personalized presentation of commodities; so, it has great application research value.

2. Literature Review

Machine learning is a comprehensive discipline. Research is done on humans to mimic human action, harvesting know-how and continuously adding functionality. The main function of machine learning is induction and synthesis.

Machine learning is essentially about finding a mapping between a set of inputs x and outputs y. The problem abstraction step can then be seen as a process of finding y. Determine what you are trying to predict. What is the quantity y in the problem? Is it discrete or continuous (corresponding to classification and regression problems)? Once you have identified the quantity to be classified (or regressed), you can start to analyze the available data and; once you know the basics of the data and understand the business logic in the data, you can start to build the training data. The main objective of this step is to find x, i.e., to extract all the data that are likely to be relevant to the predicted target value y.

2.1. Personalized e-Commerce Service. Ji and others [1] described the necessity of personalized e-commerce service. The e-commerce personalized service model based on Web mining is constructed, the basic design ideas and functions are described in detail. Rao [2], and others used the Web data mining classification technology and transaction data to describe the e-commerce personalized service model. The model describes an idea of what design and functionality can be used to build a true e-commerce service provider for your own use. Xue and others [3] started from the concept of personalized information service. Focused on six kinds of personalized services available in the e-commerce environment, proposed personalized e-commerce based on Web data mining, and studied and discussed the data resources, key technologies, and foundations. Jie and others [4] introduced the concept of personalized e-commerce service, put forward the meaning of clickstream data, analyzed the use process of clickstream data, and finally put forward an intelligent shopping guide system based on clickstream.

Gao and others [5] based on the connotation and characteristics of mobile tourism e-commerce personalized service put forward the necessary process of personalized

service, the design scheme, and the implementation path of the service. Yang analyzed [6] the current situation of e-commerce courses, then conducted in-depth research on the optimization of personalized teaching services and curriculum resources construction, and proposed some targeted optimization measures. Qiao established [7] a large-scale data personalized information model based on electronic recommendation service to provide users with better information services. Sun and others [8] proposed a travel plan recommendation system to help visitors efficiently and personalized plan their travel plans and improve their ability to travel to e-commerce sites. Jin-Juan [9] introduced how to use data mining techniques to build personalized service websites for customers based on their situations during the construction of e-commerce websites, creating a convenient, fast, and convenient online shopping environment. Wang and others [10] introduced ways to track user browsing behavior and predict user shopping behavior to provide personalized service to customers. Zhu et al. [11] adopted a computationally efficient method to solve the problem of high-accuracy real-time moving object detection in high-resolution video frames.

2.2. e-Commerce Personalized Recommendation System. Haibin and others [12] introduced the personalized recommendation, analysis, and design process for e-commerce. Moreover, the personalized recommendation prototype system is implemented to fully acquire the unique interest of different users. In order to promote dynamic and personalized product recommendation, Chen and others [13] put forward an interest-oriented approach based on clickstream data mining to cluster users. The definition of user interest is introduced as a set of preferences for commodity categories. Miao [14] proposed a method for personalized recommendation product information based on the design of mobile e-commerce personalized recommendation system. Yang [15] built a personalized recommendation system in e-commerce according to customer requirements and explained its functions and workflow. Alsubari et al. [16] specifically analyzed its structure in order to recommend the information required by the customer more effectively. Figure 1 shows the structure of the e-commerce recommendation system.

In order to provide users with differentiated services and build a personalized recommendation system model, Ma [17] gave a specific recommendation system process, system design, and system implementation based on collaborative filtering recommendation algorithm to promote the development of e-commerce system. Xu et al. [18] propose a hybrid recommendation algorithm that optimizes the problem and describe how it can be employed to generate preferences model-based recommendations for items. Han and others [19] constructed a logical model of a personalized recommendation system according to the needs of e-commerce website management and designed a personalized recommendation engine by filtering recommendation algorithm. With the continuous development of e-commerce, many people have joined the research of e-commerce recommendation system. In order to seek more accurate and effective recommendation, many techniques have been applied in this field. These technologies have been practically applied in many e-commerce product recommendation systems and have achieved good recommendation results. Sun and others [20] realized the design process. Figure 2 shows the results of data mining:

Yan-Xia and others [21] combined with the B2C e-commerce website construction background, by applying the K-means algorithm that is trapped in the local minimum, and the defects of the initial sensitive cluster center are applied to the customer segmentation to obtain customer groups with different characteristics Meng Fanqi. The ultimate support company provides specific referral services for each type of customer, with limited resources to improve customer purchases. Luo [22] introduced the method of using multiagent technology optimization of models, design processes, and structures in conjunction with log mining. Cai [23] proposed a personalized recommendation system for e-commerce based on variable precision rough sets. Wang et al. [24] elaborated on the mobile quotient model and discussed the extent to which it is important. Khalaf et al. [25] used blockchain technology to build a node identification system based on the data storage of wireless sensor networks.

2.3. The Influencing Factors of e-Commerce Shopping. With the rise of online shopping platforms, it is important to understand consumers' propensity to purchase based on e-commerce platforms if they profit from them. Guo et al. [26] developed a causality model that allows for the calculation of causal relationships, and total sales show an increasing trend as reputation and sales increase. Chowdhury and others [27] found a positive correlation between online shopping incentives and respondents' shopping behavior. Zhao and others [28] determined the relevant factors by analyzing the influence of credit, applied the entropy method to the questionnaire analysis, and finally obtained the importance of an impact factor through statistical calculation, which provided an effective reference method for selecting appropriate credit evaluation indicators. Wu et al. [29] focused on the factors that influence consumer trust to build a market place model of confidence in consumers. Yuan and others [30] through the questionnaire survey of college students' shopping behavior, under the conditions of e-commerce, the time efficiency of goods, information, and price, the type of goods, logistics, and payment will have a significant impact on consumers' shopping behavior. Yan and Du [31] conducted an empirical study on online based shopping. The results show that there are many factors that influence shopping satisfaction. Al-Amiri and Aghdaie's study [32] identified factors that influence online purchasing trust attitudes.

Yu [33] discussed the influencing factors of buyer credit in C2C e-commerce from four aspects: online buyers, sellers, shopping websites, and e-commerce environment. A new perspective was chosen to explain the consumer's acceptable behavior. In the basic technology acceptance model (TAM), sales promotion, personal innovation, and social influence were added. Chooprayoon [34] seeks to explore the impact of five elements on the uptake of e-commerce technologies.

Wang and others [35] used statistical software to process the actual data based on questionnaires and systematically analyzed the influencing factors of tourism e-commerce. Shao and others [36] mainly studied three aspects (environment, organization, and technology) that affect e-commerce

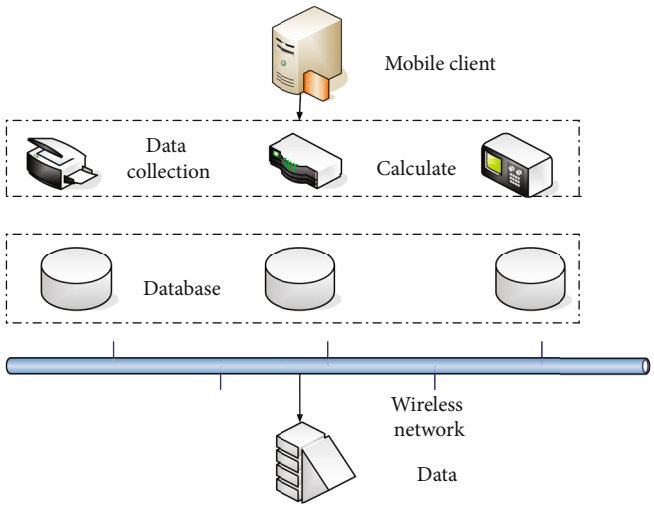

Figure 1: Structure of the e-commerce recommendation system.

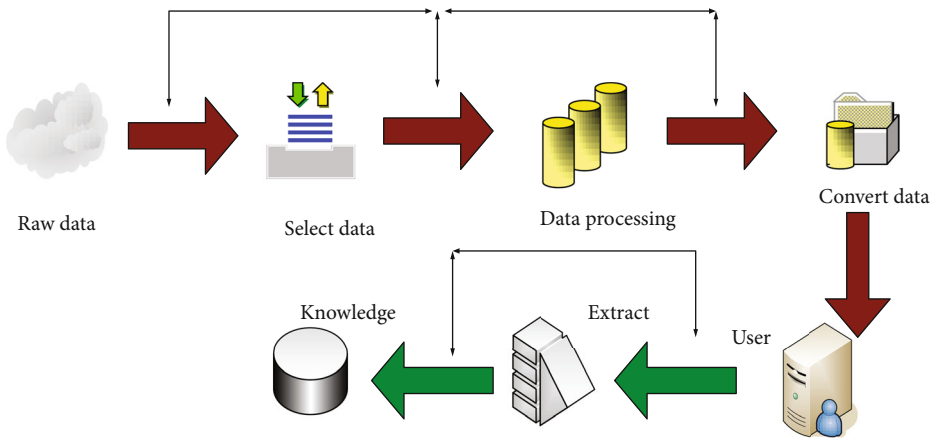

Figure 2: Data mining structure diagram.

applications. Yi and others [37] explored the factors affecting the network capabilities of e-commerce enterprises by studying the measurement factors of network resource elements, institutional environment elements, and enterprise network capability factors.

The e-commerce industry is developing rapidly, the requirements of online shopping users for goods are gradually increasing, and the purchasing behavior of users is also changing subtly. Moreover, the speed at which the e-commerce platform integrates product information has also been greatly improved, and users can compare various aspects of the product in a short time. By sharing product information and product reviews with other users, you can fully understand the attributes of the product, including the price trend of the product, before purchasing. The ultimate goal of personalized recommendation service is to enable users to purchase goods. The main content of this paper is to collect various factors that affect the behavior of user online shopping in the process of e-commerce [38]. On this basis, the model of influencing factors of e-commerce personalized information recommendation is constructed. Through the analysis and design of the influencing factors of consumers' purchase of personalized goods, the proposed model is tested and revised, and personalized information recommendation service model is established.

2.4. Research Hypothesis. At present, the convenience brought by the business activities through the Web and the transaction speed it produces have become the key driving force for the rapid development of e-commerce. On the other hand, the e-commerce activities involving clients are also undergoing tremendous innovation. If it is possible to track the browsing behavior of customers on the Web and conduct pattern analysis, it will shorten the distance between sellers and customers, allow sellers to better understand the needs of their customers, and carry out targeted e-commerce activities.

2.4.1. Customer Factors. The personal factors that affect the customer's purchase of personalized recommended products are mainly the customer's income level and online shopping experience.

(1) Income level: personalized products are more inclined to recommend the products that users prefer. The difference in customer income levels will affect their shopping attitude towards personalized recommended products

Suppose H1: the higher the level of customer income, the easier it is to purchase personalized recommendation products.

(2) Online shopping experience: users in the online shopping process during the information collection process and purchase decision-making stage will be affected by the factors of their experience. The personalized recommendation product is the product that the merchant actively recommends to the user, and the requirement for the user's online shopping will be higher

Suppose H2: the more vibrant the online shopping experience, the stronger the willingness of online shopping personalized recommendation products.

2.4.2. Commodity Value

(1) Commodity price: online shopping customers usually search for various similar products on the network to find goods at a relatively low price. If the price of the personalized product recommended by the website to the user is appropriate, it will save the user a large amount of search time and is more conducive to the purchase of personalized recommended products

Suppose H3: the price of personalized recommendation will affect users' purchase intention.

(2) Commodity quality: as with commodity prices, the quality of a product is also a major factor affecting the user's willingness to purchase personalized products. Consumers tend to be cheaper by quality assurance

Suppose H4: the quality of personalized recommendation products will affect users' willingness to purchase. Table 1 is the product score matrix:

Table 1: Commodity score matrix.

Grade	Product 1	Product 2	Product 3
Consumer 1	3	2	1
Consumer 2	4	0	3
Consumer 3	1	3	5

(3) The relevant degree of product recommendation: the personalized recommendation product is a product recommended by the website according to the data left by the user browsing the web and the shopping process. Therefore, the relevance of the recommended product to the user's ideal product directly leads to whether the user will purchase the product. Classification analysis and cluster analysis are reciprocal processes. Begin to use cluster analysis to cluster the data and divide it into several clusters, then use classification to analyze the data set to get the description of each category, and then put it into the appropriate category according to the characteristics of the new data. It is also possible to reclassify the data by using the class descriptions as new classification rules to obtain more accurate results. This has been repeated until a satisfactory result is obtained. During the experiment, when the system recommends to the user, if the user bookmarks or buys it, it is considered that the user is satisfied with the recommended result; if the user no longer needs the recommendation after the user chooses, it is considered to be dissatisfied with the result; if the user clicks to view the recommended product, however, if it is not purchased or collected, it is regarded as general

Suppose H5: the correlation between recommended goods and ideal products will affect users' shopping intention. Figure 3 is the architecture diagram of the e-commerce recommendation system:

2.4.3. Business Image

(1) Credit evaluation: the reputation of a merchant in the online shopping process will directly affect the user's preference for his or her product; that is, the high reputation of the merchant is beneficial to the user to purchase the commodity. The evaluation of the merchants who have purchased the product has dramatically affected whether the user purchased the product later

Suppose H6: the higher the credit rating of the merchant, the more favorable it is for the user to purchase the personalized product.

(2) Quality of service: the quality of service includes the following: presales consultation, product information in the link, delivery time, delivery service, after-sales consultation, and return guarantee. The high quality of the service of the merchant can also affect the user's willingness to purchase the product, and the satisfaction level of the user is improved

Suppose H7: the quality of service of online merchants is also one of the factors that influence users' purchase intention; that is, high quality of service is beneficial for users to purchase personalized goods.

2.4.4. Willingness to Shop. There is an excellent correlation between shopping attitude, shopping intention, and shopping behavior. The attitude of users to the goods will affect their willingness to purchase, and the willingness to purchase will directly affect whether the purchase will occur next. Therefore, if a user has a willingness to shop for a

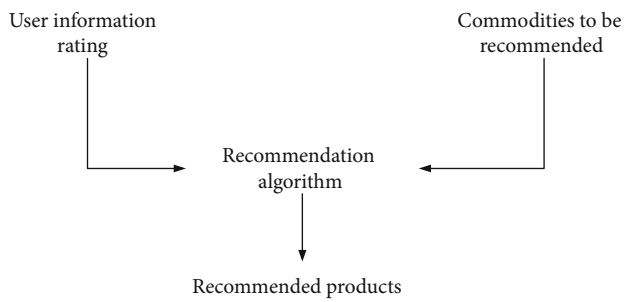

Figure 3: Architecture diagram of the e-commerce recommendation system.

product, the degree of shopping behavior for the product will also increase.

Suppose H8: a higher shopping willingness can affect users' shopping behavior for personalized recommendation products. Content-based recommendation is based on the similarity between items. This kind of recommendation first needs to analyze the customer's content analysis of the items that have been rated, generate a customer information archive, then sort the selected items from the existing items that are similar to the new archive (according to the ratings).), and recommend to users based on customer feedback.

3. Research Method

3.1. Data Collection and Data Analysis. According to Amazon's analysis, the mainstream trend of online shopping in 2017 is the population with high income, high education, rationality and maturity, and the pursuit of high-quality life after 1980 and 1990. To ensure the precision of the outcome, the survey scope is defined as all individual users who have experienced online shopping on retail websites. Through paper questionnaires and online questionnaires, 245 questionnaires were distributed, and 231 were returned. Excluding the unqualified questionnaires, 223 questionnaires have application. In the sample of this survey, the age of the respondents showed mostly after 1980 and 1990. The number of male individuals is slightly smaller than that of females, shown in Table 2.

3.2. Sample Survey

3.2.1. Reliability Analysis. Reliability refers to the degree of consistency of results obtained by repeating measurements on the same object in the same way. The method used in this paper to measure the reliability coefficient of the scale is the Cronbach α reliability coefficient. When the value is between 0 and 1, the value tends to 1, and the reliability of the scale is higher. When the Cronbach α reliability coefficient is higher than 0.80, the scale already has very high reliability. When the Cronbach α reliability coefficient is between 0.6 and 0.8, the reliability of the scale is better, and the reliability coefficient of the scale is weak when the value is below 0.6; the item of the scale is amended.

SPSS analyzed the reliability of the data obtained from the survey. The results are shown in Table 3.

Table 2: Statistics of the basic situation of the investigators.

	Classification	Number of samples	The proportion
Career	Student	69	30.9
	Institution	45	20.2
	Enterprise employee	56	25.11
	Freelance	30	13.5
	Other	23	10.3
Education	Master degree and above	62	27.8
	Undergraduate	101	45.3
	College	32	14.3
	High school and below	28	12.6
Income	More than 8000	41	18.3
	5000-8000	72	32.3
	3000-5000	88	39.4
	Less than 3000	22	9.9
Gender	Male	121	54.3
	Female	102	45.7

As shown in Table 3, the Cronbach α coefficient of all variables is higher than 0.75, indicating that the reliability of the item of this scale is relatively high, and the overall reliability of the scale reaches 0.903, which can be used for the next step of validity analysis.

3.2.2. Validity Analysis. The validity analysis refers to the analysis of the accuracy of the scale quantity expression to the measurement index. The degree of validity is determined by the degree of coincidence of the measured objects. The higher the degree of coincidence, the higher the effect.

In this paper, the two methods of cumulative variance contribution rate and KMO sample measure are used to analyze the validity of the sample. When the KMO value is more significant, it indicates that the scale is more suitable for validity analysis. When the KMO value is lower than 0.5, it indicates that the scale is not suitable for validity analysis. When a variable has only two items, the KMO value is just 0.5. The validity criterion of the questionnaire set by this survey is that the cumulative variance contribution rate of the variables is higher than 50%, and the validity analysis results are shown in Table 4.

The validity analysis showed that the KMO value was 0.5 because the quality of the product was only two items. The KMO values for the other seven variables are higher than 0.7, and the Sig. values are all 0.000. The cumulative variance contribution rate of all variables was higher than 50%. The validity of the questionnaire is good, and there are a strong correlation and validity between the data.

3.3. Inspection and Correction of Structural Equations. The SEM model is used to study the shopping willingness and three variables that influence the willingness to shop: the customer factor, the value of the commodity, the

Table 3: Reliability test results of each variable.

	Variable	Number of items	Reliability	
Customer factor	Income	3	0.782	0.791
	Online shopping experience	3	0.761	
Commodity value	Price	3	0.816	0.813
	Quality	2	0.801	
	Correlation	3	0.812	
Business image	Credit	3	0.824	0.831
	Service quality	3	0.801	
Shopping intention		4	0.871	
Shopping behavior		3	0.881	

Table 4: Validity analysis results of variables.

	Indicator quantity	Number of items	KMO		Cumulative variance contribution rate (%)
Customer factor	Income	3	0.752	0.75	81.9
	Online shopping experience	3	0.751		78.1
Commodity value	Price	3	0.762	0.759	87.2
	Quality	2	0.50		84.2
	Correlation	3	0.763		83.1
Business image	Credit	3	0.747	0.753	81.5
	Service quality	3	0.759		87.5
Shopping intention		4	0.801		77.2
Shopping behavior		3	0.756		81.1

relationship between the image of the business, and the influence of the willingness of shopping on the shopping behavior. Firstly, the model structure of this study is proposed, and then the indicators are tested. The model is revised based on the results of the software, and the proposed correction indicators are provided to obtain the most reasonable research model. Moreover, in the end, verify the specific assumptions.

3.3.1. Construction of the Overall Structural Equation Model. The model is reflected in personal customer factors, commodity attributes, business characteristics, the three variable subordinate dimensional income level, online shopping experience, commodity prices, product quality, recommendation relevance, and credit evaluation. The quality of service will have an impact on the willingness to shop. At the same time, the willingness to shop will also have an impact on the shopping behavior. The final SEM model is shown in Figure 4.

3.3.2. Estimation and Test of the Structural Equation Model. The model's various fitness indicators are summarized. Finally, it is found that the summary results of each fitting index after the construction of this model are basically up to standard.

According to the results of the above Table 5, we know that the model's final $\chi^2/\mathrm{df} = 2.49 < 3$, and the model has a good fit. The value is lower than 3 and usually indicates that the model has a good fit. The RMSEA indicator is 0.051, TLI (normal fit index), NFI (nonnormal fit index), CFI (comparison fit index), and IFI (value added a fit index) also range from 0 to 1, and the closer the value is to 1, the better the fit of the model. If the value is higher than 0.9, the model studied is generally considered to have a high degree of fit. The values of these indicators for this model are all between 0.9 and 1. Therefore, the overall fit of the model established in this study is good, all the indicators are within the standard value range, and the established model is the final analysis model.

4. Analysis Results

Through the above analysis, the final model of the study is obtained, and the simplified path coefficient of each variable is listed.

The relationship between the specific detailed analysis variables and all the standardized path coefficients are collated. The final results are shown in Table 6 and Figure 5.

The results of experiment 1 show that with the increase of the number of users, the user satisfaction of each recommendation is getting higher and higher; when the number of users is the same, the user satisfaction of user recommendation and content-based recommendation are similar. However, after the integration of these three recommendations, the user's satisfaction is significantly improved. The results of experiment 2 show that with the increase of the number

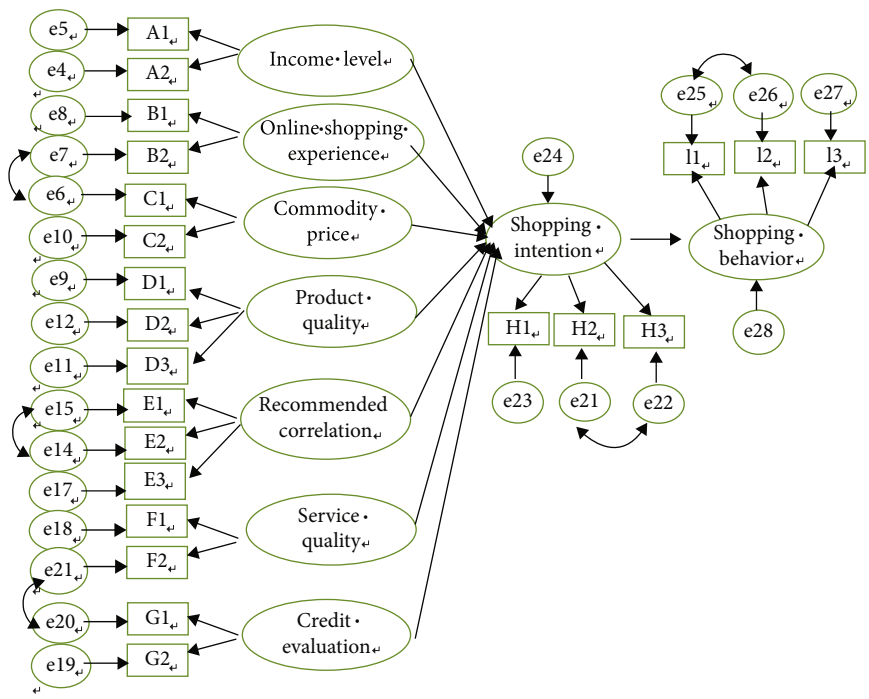

Figure 4: Overall structural equation model.

Table 5: Model summary indicator results.

X^2	CFI	IFI	TLI	NFI	RMSEA	Df	χ^2/df
1521.41	0.93	0.92	0.912	0.919	0.051	610	2.49

Table 6: Final results of the relationship between variables.

Relationship	Regression weights	S.E.	Standardized regression weights	C.R.
Shopping intention<—income level	0.21	0.051	0.207	3.24
Shopping intention<—online shopping experience	0.18	0.048	0.172	2.76
Shopping intention<—commodity price	0.06	0.067	0.051	0.65
Shopping intention<—product quality	0.07	0.019	0.068	3.24
Shopping intention<—recommended relevance	0.08	0.025	0.075	2.91
Shopping intention<—service quality	0.07	0.023	0.067	2.67
Shopping intention<—credit evaluation	0.04	0.013	0.043	3.30
Shopping behavior<—shopping intention	0.16	0.025	0.171	7.10

of products, the recommendation coverage rate of all recommendation strategies will decrease, but for the same number of products, the recommendation coverage rate of the fusion algorithm is significantly higher than that of other strategies. In summary, the recommendation system based on the fusion algorithm has obvious improvement in the push rate and accuracy.

From the above table, we know the impact of the eight aspects of the study on the willingness to shop. The normalized path coefficient values are all greater than zero, and the P values all exhibit a significance at the 0.001 level. Therefore, these eight aspects (income level, online shopping experience, commodity price, product quality, recommendation relevance, credit evaluation, service quality) will have a significant positive impact on shopping willingness. The higher the recognition of the sample for these eight aspects, such as the higher the income, the richer the online shopping experience, the higher the recognition of quality, the better the recommendation, the higher the credit evaluation, the higher the quality and popularity, and the higher the ease of use. Then, there will be a stronger shopping willingness. Therefore, it is also verified that this assumption is true. In

Figure 5: Final model.

addition, from the standardized path coefficient, the impact of the two dimensions of income level and online shopping experience of shopping will have a greater impact on other dimensions.

5. Conclusion

Currently, the success of e-commerce sites often depends on maintaining existing users and turning potential buyers into buyers. Therefore, how to provide different information and services to different users according to their individual characteristics, so as to attract new users and retain old users, has become a hot issue that businesses and scholars pay attention to and study. In this paper, the SE model is constructed, and a simple revision of the model combined with the indicators provided by AMO finally makes the common model metrics reach the standard range. Therefore, the final model is feasible and reasonable. After the model is established, the hypothesis proposed in this study is verified by using the normalized path values of the SEM model and checking whether it is significant to verify the hypothesis. The conclusion is as follows:

(1) Suppose H1: the influence of income levels. (established)

(2) Suppose H2: the influence of the online shopping experience (established)

(3) Suppose H3: commodity prices will have a significant positive impact on shopping intention (established)

(4) Suppose H4: quality impact (established)

(5) Suppose H5: recommendation relevance significantly positively affects shopping intention (established)

(6) Suppose H6: credit rating impact (established)

(7) Suppose H7: service quality impact (established)

(8) Suppose H8: shopping intention will have a positive effect on shopping behavior (established)

According to the experimental analysis, the standardized path coefficient value for shopping path on shopping behavior is 0.171 and shows a sign at the 0.001 level, thus indicating that shopping also positively influences shopping behavior. The higher the willingness to shop, the more likely shopping behavior will occur, validating the hypothesis. Income level, shopping experience, product price, and credit rating can have varying degrees of influence on shopping behavior. And the flexibility of the recommendation system is insufficient. The adjustment of the types of customer evaluations and the imperfect calculation lead to the unscientific calculation of the customer evaluation part of the recommender system. The fusion of recommendation lists generated by several methods is relatively rigid and needs to be further improved.

6. Suggestion

Based on the existing personalized recommendations of an e-commerce website with machine learning technology, this paper analyzes the factors that affect users' shopping through a questionnaire survey. SPSS software verified the data obtained from the survey. Finally, the structural model was verified using AMOS software. So far, my research on the application of web data mining technology in e-commerce is still in its infancy. Due to my time and ability, most of the above are simulation results. The platform has not been realized. This paper only simulates in offline state, and there is still a lot of research space in the future. Based on the previous analysis and summary, this article believes that the following measures can be taken to improve personalized recommendations:

6.1. Recommendation of Topic Information. When new consumer targets emerge, they can be characterized by product

properties through the form of a questionnaire survey and pass the private message in the station according to the user's wishes and needs. The product information is recommended to the user using notification and sending an email or text message.

6.2. Recommendation of Interest Mining. e-commerce companies can use technology to access the potential needs of their users. By analyzing and mining the information generated by users' access to information resources, they can predict future development trends and obtain users' personalized views.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgments

This work was supported by the 2019 Philosophy and Social Science Project of Hubei Provincial Department of Education (research on the influence of personalized recommendation on consumers' purchase decision in mobile commerce environment, No. 19G097) and School Level Scientific Research Innovation Team of Wuhan College in 2020 (new media product operation innovation team, No. kyt202001).

References

[1] C. Ji, K. Wang, and X. Chen, "Design of E-Commerce Personalized Service Model Based on Web Mining," in *2010 International Conference on Internet Technology and Applications*, pp. 1–4, Wuhan, China, 2010.

[2] T. K. R. K. Rao, S. A. Khan, Z. Begum, and C. Divakar, "Design of E-commerce personalized service model based on web mining classification technique," in *2013 IEEE International Conference on Computational Intelligence and Computing Research*, pp. 1–4, Enathi, India, 2013.

[3] Y. Xue and J. Chen, "Research and design of web data mining in personalized e-business," in *Proceedings of the 2009 International Symposium on Web Information Systems and Applications*, 2014.

[4] W. Jie and Z. Wang, "The Study on Clickstream-Based E-Commerce Personalized Service Mode," in *2010 International Conference on E-Business and E-Government*, pp. 161–163, Guangzhou, China,, 2010.

[5] G. A. Jing, Z. H. Ruo-nan, and W. U. Hong, "Scheme design of personalized service of tourism mobile E-commerce," *Commercial Research*, vol. 59, p. 166, 2017.

[6] Y. Yang, "Research on personalized teaching service and curriculum resources construction based on E-commerce," *Computer & Telecommunication*, 2017.

[7] L. Qiao, "Research on e-commerce personalized information recommendation service model based on big data," *Electronic TEST*, 2017.

[8] Y. Sun and X. U. Lin, "A Research of Personalized Service about Tourism E-Commerce Sites Based on Case-Based Reasoning," *Journal of Inner Mongolia Normal University*, 2016.

[9] H. U. Jin-Juan, "Application of data-mining technology in the construction of personalized E-commerce sites," *Journal of Luohe Vocational Technology College.*, 2014.

[10] Z. Wang, K. Han, and S. Huang, "Study on the user's interested strength level algorithm in intelligent E-commerce," in *2016 IEEE International Conference on Electronic Information and Communication Technology (ICEICT)*, pp. 103–106, Harbin, China, 2016.

[11] H. Zhu, H. Wei, B. Li, X. Yuan, and N. Kehtarnavaz, "Real-time moving object detection in high-resolution video sensing," *Sensors*, vol. 20, no. 12, p. 3591, 2020.

[12] W. U. Haibin, L. Liu, X. Liu, and Q. Gao, *Design and Implementation on Personalized Recommendation System of E-Commerce*, Journal of Inner Mongolia University of Technology, 2012.

[13] L. Chen and Q. Su, "Discovering user's interest at E-commerce site using clickstream data," in *2013 10th International Conference on Service Systems and Service Management*, pp. 124–129, Hong Kong, China, 2013.

[14] J. F. Miao, "Design and implementation of personalization recommendation system in Mobile E-commerce," *Advanced Materials Research*, vol. 989-994, pp. 4506–4509, 2014.

[15] J. Yang, "Construction of Personalized Recommendation System in E-Commerce," *Modern Computer*, 2012.

[16] S. N. Alsubari, S. N. Deshmukh, A. A. Alqarni et al., "Data analytics for the identification of fake reviews using supervised learning," *CMC-Computers, Materials & Continua*, vol. 70, no. 2, pp. 3189–3204, 2022.

[17] X. Ma, "Research and implementation of an e-commerce personalized recommendation system based on the cooperative filtering algorithm," *Microcomputer & Its Applications*, 2014.

[18] T. Xu, J. Tian, and T. Murata, "Research on personalized recommendation in E-commerce service based on data mining," *Lecture Notes in Engineering & Computer Science*, vol. 2202, no. 1, pp. 313–317, 2013.

[19] M. Han, "The design and implementation of E-commerce personalized services based on collaborative filtering recommendation system," *Applied Mechanics and Materials*, vol. 687-691, pp. 2039–2042, 2014.

[20] L. Sun and W. Xu, "E-commerce personalized recommendation system based on web mining technology design and implementation," in *2015 International Conference on Intelligent Transportation, Big Data and Smart City*, pp. 347–350, Halong Bay, Vietnam, 2016.

[21] H. U. Yan-Xia, J. X. Liu, and Z. M. Hong, "Application of K-Means Algorithm Based on Hybrid PSO in the Customer Segmentation of B2C E-Commerce," *Computer Knowledge & Technology*, 2015.

[22] Y. Luo, "E-Commerce Personalized Recommendation System Design Based on Multi-Agent," in *Advances in Computer Science and Information Engineering*, pp. 159–164, Springer, Berlin, Heidelberg, 2012.

[23] Y. P. Cai, "Construction personalized recommendation system of E-commerce based on variable precision rough set," *International Journal of Advancements in Computing Technology*, vol. 4, no. 11, pp. 125–131, 2012.

[24] Y. M. Wang, R. L. Wang, and D. X. Xu, "Mobile E-commerce personalized information recommendation model," *Applied Mechanics and Materials*, vol. 687-691, pp. 2136–2139, 2014.

[25] O. I. Khalaf and G. M. Abdulsahib, "Optimized Dynamic Storage of Data (ODSD) in IoT Based on Blockchain for Wireless Sensor Networks," *Peer-to-Peer Networking and Applications*, vol. 14, no. 5, pp. 2858–2873, 2021.

[26] X. Guo, P. Yu, and X. J. Wen, "Study on the influencing factor of C2C E-commerce consumption tendency based on online shopping platform," *Applied Mechanics and Materials*, vol. 651-653, pp. 1721–1725, 2014.

[27] E. K. Chowdhury and R. Chowdhury, "Online shopping in bangladesh: a study on the motivational factors for e-commerce that influence shopper's affirmative tendency towards online shopping," *South Asian Journal of Marketing & Management Research*, vol. 7, no. 4, pp. 2249–2877, 2017.

[28] S. Zhao, J. Jiang, and M. Luo, "The comparison and analysis of seller's credit rating influence factors in e-commerce," in *2011 International Conference on Business Management and Electronic Information*, pp. 503–506, Guangzhou, 2011.

[29] X. F. Wu, J. Zhou, and X. Yuan, "The research of factors which effect B2C E-commerce Trust - Based on the mechanism of process," *Advanced Materials Research*, vol. 591-593, pp. 2583–2586, 2012.

[30] H. Yuan, L. U. Shan, and M. F. Wang, "Analysis of the influence of E-commerce on consumers' traditional shopping behaviors," *Commercial Research*, vol. 2, pp. 211–216, 2011.

[31] Y. Yan and S. Du, "Empirical study for the influence factors of customer satisfaction based on B2C online shopping," *Journal of Computational and Theoretical Nanoscience*, vol. 13, no. 12, pp. 10364–10368, 2016.

[32] F. A. Aghdaie, S. Fathi, and A. Piraman, "The Comparative Analysis of affecting Factors on Purchasing Domestic and Imported Cars in Iran Market - Using AHP Technique," *Interdisciplinary Journal of Contemporary Research in Business*, vol. 3, no. 2, 2011.

[33] F. Yu, "The Analysis of the Factors Influencing the Buyer's Credit in C2C E-Commerce," *Journal of Suihua University*, 2017.

[34] V. Chooprayoon, "A study of factors influencing the adoption of e-commerce technology in small and medium enterprises (smes) in the kingdom of Thailand," *Chooprayoon Vasin.*, 2011.

[35] L. Wang, R. Zhang, and H. Ruan, "A personalized recommendation model in E commerce based on TOPSIS algorithm," *IGI Global.*, vol. 12, no. 2, pp. 89–100, 2014.

[36] P. Shao, L. Wu, Q. Su, and J. Yang, *Influence factors of E-commerce adoption: an empirical research in special markets*, WHICEB, 2013.

[37] H. F. Yi and F. J. Li, "Analysis on Influence Factors of E-commerce Venturing Model," in *2016 International Conference on Smart Grid and Electrical Automation (ICSGEA)*, pp. 147–150, Zhangjiajie, China, 2016.

[38] N. O. García, M. D. Velásquez, C. T. Romero, J. O. Monedero, and O. Khalaf, "Remote academic platforms in times of a pandemic," *International Journal of Emerging Technologies in Learning*, vol. 16, no. 21, pp. 121–131, 2021.