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Retraction

Retracted: Research on Home Product Design and Intelligent Algorithm Recommendation considering Ergonomics

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Wang, "Research on Home Product Design and Intelligent Algorithm Recommendation considering Ergonomics," *Journal of Sensors*, vol. 2022, Article ID 1791269, 10 pages, 2022.

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Research Article

Research on Home Product Design and Intelligent Algorithm Recommendation considering Ergonomics

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Under the modern design concept, consider ergonomics to design home products. With the progress of civilization and technology, the improvement of life quality in the process of urbanization, and the increasing abundance of home life and home products, people's requirements for living environment and environmental products are continuously improving. In order to further meet the necessities of life and solve the reasons such as limited living space at home, people are no longer satisfied with purchasing household products in large quantities but are more suitable for household needs. According to the user's requirements for ergonomic home product design, a criterion layer is established, and the weight of the criterion layer is calculated to obtain its corresponding weight value. It can be obtained that consumers think that safety is the most important, followed by ease of use, functionality, and aesthetics. In the second criterion level, the order of importance is stable operation, safe use of materials, invisible circuit, strong practicability, massage function, safety guardrail, convenient installation, easy cleaning, intelligent operation, home style, structural strength, easy to move, natural materials, air purification, easy disassembly, suitable size, simple shape, convenient function, timely after-sales, soft color tone, noise reduction, simple decoration, single color matching, and comfortable function. The addition of the nearest neighbors improves the accuracy of the CFCNN-CL algorithm and the REPREDICT PCC algorithm in terms of smart algorithm recommendations for home products considering ergonomics. But compared between the two, the CFCNN-CL algorithm has better performance and better accuracy than the REPREDICT PCC algorithm. In terms of the influence of data sparseness, UCF-Jaccard has a smaller MAE value than other methods in general and is less susceptible to the influence of sparse data, and the MAE value does not change much. Among the group filtering methods, the RRP-UICL method has better prediction accuracy than the commonly used group filtering methods.

1. Introduction

In the context of a design item, the article depicts ergonomic studies and analyses that can be performed on concurrent engineering design models at any phase of the design procedure. During the design procedure, ergonomic experts were asked to suggest designers on end-user feature and assist in evaluating the impact of design choices made under the perfect future activity methodology. Therefore, ergonomics is defined as a factor of innovation and safety [1], because an ergonomic way enhances quality of life and activities of daily living. Gerontology decreases the results of age-related constraints through technological equipment and special designs for the family environment. Physical fall makes daily activities at home more difficult as you age. The article focuses on "common sense" and specific design recommendations for entrances and kitchens to improve independence in older adults, while geriatric technology can play a special role in improving comfort and safety for older adults [2]. Globalization, technological intricacy, the development of more ripe markets that require diverse or high-quality products, and competitive pressures to decrease development time and costs have led to the wider use of methods and technologies that deal with human factors in different ways. Consequently, a number of approaches and techniques have been developed, each offering different and complementary approaches to better understand human-relevant design requirements. An overview of current trends in consumer product design involves ergonomics and human factors to understand the strengths, weaknesses, and challenges facing researchers and practitioners; methodologies and techniques throughout the product life cycle (PLC), including design and the innovation process, are important [3]. Consider that ergonomic product quality is an essential part of successful product development. Product designers involved in basic product development activities must support an approach that considers ergonomic and other product requirements. The first part examines how people working in product development organizations communicate with their product users, the second part analyzes the factors that influence ergonomic integration in product design, and the third part evaluates and discusses. This paper introduces computer-aided ergonomics as a means of integrating ergonomics with product design; the purpose of part IV is to explore how human simulation tools can help designers consider the diversity of the human body. This work evaluates different approaches to generate specific virtual series that can be used as test suites for matched trials in virtual designs. Research has shown a greater understanding of design approaches that support the integration of ergonomics into the product design process, with a focus on anthropometric diversity in vehicle design [4]. Introduce ergonomic design thinking into all aspects of product design for research, analyze the inverse results of the use and operation of ergonomics from two aspects of physiological and psychological factors, and put forward the rational application of ergonomic design thinking in product design importance in [5]. How to follow ergonomics in product design, take the humanization, personalization, and emotional humanization factors of products as inspiration, examine the metric and coordination relationship between human factors and human-machine in traditional products, and connect some modern product cases for discussion and express the relationship between modern product design factors and human body size coordination is the field of interest. Under certain circumstances, the conclusion of ergonomics is the basic requirement of product design. Only when the most basic ergonomic standards are met can the product meet the basic requirements of the product for human use [6]. Kinesiology is a science focused on studying human health and reducing fatigue and discomfort through product design. This science is widely used to design all kinds of furniture in homes and offices, keeping in mind that furniture is designed for the user. The study focused on the issues faced by students at Shah Jalal University of Technology, Sylhet, Bangladesh, when using tabloid chairs in their everyday classrooms. The purpose is to identify ergonomic perspectives through the use of tabloid chairs and related limitations or issues in the classroom. To understand the limitations of using the tabloid chair, an updated tabloid chair was designed and developed based on anthropometric data obtained from these 160 students. The tabloid chair was produced taking into account the proposed ergonomic design [7]. Using the DFA method in the case of ergonomic intervention in the product redesign process of a home appliance enterprise is helpful to obtain the technical solution used by the product. The assembly method is aimed at reducing various assembly procedures, reducing the number of parts, and facilitating the assembly process. QFD, Kano, and Pugh analyses are some other examples of methods and techniques used in the industry to combine a participatory approach to ergonomics with a design and DFA perspective. However, in addition to simplifying the design structure and reducing assembly costs, the use of the DFA method can also be used in product redesign situations to improve workplace ergonomics [8]. The generation and development of ergonomic skills in product design and development can be understood as a dynamic innovation process created by internal and external forces within an organization. Using a comparative case study approach, it focuses on six organizations (three pairs) operating at their New Zealand manufacturing base. Data was collected through in-depth interviews, documents, archival sources, and observations. Provide a framework for understanding the emergence and evolution of ergonomic features in product design and development. While ergonomics is the core concept of this model, four other key elements were also identified. These are personnel procedures, top management orientation, organizational configuration, and external environment [9]. On the basis of understanding and comparing various mainstream recommendation algorithms, the collaborative filtering algorithm is mainly tested, and an improved user model filtering recommendation algorithm is proposed. The algorithm builds an offline user model, which enables the algorithm to achieve better recommendation performance. Two series of experiments were designed based on mean absolute error (MAE). A series of experiments tested the parameters of the algorithm, and another series of experiments compared the proposed algorithm with other algorithms. Experimental results show that the proposed method performs well in both recommendation accuracy and recommendation effectiveness [10]. The new algorithm is a data-driven Intelligent Train Operation (ITO) algorithm that derives monitors from driver experience and uses input and output data to optimize online through downhill grades. The proposed algorithm is tested in a MATLAB/Simulink simulation model using real data from the Beijing Yizhuang subway line. Compared with the Proportional Integral Derivative (PID) algorithm, the algorithm has the advantages of low energy consumption, high comfort, and high parking accuracy and can meet the dynamic travel time control. Furthermore, the results of the ITO algorithm are comparable to those of the driver, both for runway transitions and working modes [11]. Simple response times cannot be directly used to estimate the response speed of different signal patterns in a multisensory console. In this choice-response task, a better visual intensity effect was observed, which was more pronounced in the SR-mapped mating conflict condition. Based on studies showing that spatial SR compatibility and signal modality are two important interface design factors for improving operator response performance in multisensory consoles, ergonomic recommendations have been developed to improve interface design in multisensory consoles based on these findings [12]. Key challenges and advances in smart workplaces and personalized ergonomics, gathering the most relevant results from various international research projects, are divided into three main parts: personalized ergonomic examination to prevent musculoskeletal disorders and improve the workplace, the need for practical and reliable risk assessment methods, and ubiquitous technology in the smart workplace, identifying opportunities and challenges for technology-based interventions and security and privacy issues in the smart workplace. Transforming work environments into healthy and smart spaces can not only support ergonomic experts, workers, and employers but also provide solutions for the sustainability of our current social safety net [13]. A method, system, and computer program for promoting the ergonomic health of computer workplace users are presented; the method includes the step of detecting problems with computer workplace ergonomic users, wherein the ergonomic issues are relevant to current reality time. A user health algorithm is implemented to generate ergonomic recommendations, using the user's work parameters as input data to present ergonomic recommendations to correct ergonomic issues for the user [14]. Intuitive tools combine virtual reality with physics-based avatars for ergonomic research. In a real-time physics simulation, the user can manipulate the avatar to explore different poses, and the user can cause the avatar to apply forces to its environment while controlling shared torque. The virtual human uses a programming-based square controller to control the torque, ensuring a dynamically consistent position and torque of the joints. The tool features hand push experiments with different morphologies and target positions. The quantitative results obtained in the experiments are consistent with the expected effects of morphology and target position on joint torque, making the method promising in ergonomic conditions during workplace prototyping [15].

2. Ergonomic Home Product Design

2.1. Problems Existing in Home Product Design. At this stage, almost all household items in our country are very similar. This phenomenon has seriously restricted the development of household product design in our country. China's household products have always been low-end, and although they occupy the international market at low prices, there is no end to the problem. Among the Chinese household goods, there is only the "Chinese style" in the Ming and Qing dynasties. The articles are used all the time and gradually run out of new ideas. On the contrary, in the process of exploring Chinese culture and interpreting Chinese elements from a Western perspective, Western design always emphasizes new concepts and design styles. The home furnishing market has no unique features. Following Western fashion and blindly copying, "no design" has become the status quo of the current home furnishing market. When analyzing the current situation of home furnishing products in our country and synthesizing the market conditions of home furnishing products, the human-machine coordination, human-machine environment coordination, cultural identity, and emotional attraction of products should be considered in home furnishing design. Furniture products and other aspects are the research content of product design and human design methods. To understand the classification of home products and product analysis of classic home brands, we will start with ergonomic theory and analyze the relationship between product design and ergonomics, as shown in Figure 1.

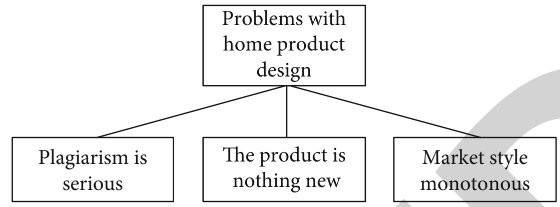

Figure 1: Problems existing in home product design.

Almost all household products in our country look alike, which greatly restricts the development of the design of household products in our country.

The Chinese elements contained in domestic household products are only "Chinese style" during the Ming and Qing dynasties. These elements have been used all the time and have no new ideas.

The domestic home furnishing product market does not have its own unique characteristics. It has always followed the fashion trend of the West and blindly copied it.

2.2. The Embodiment of Ergonomics in Home Product Design. When it comes to solving the "human" problem of a system, the primary approach to ergonomics is to create machines and environments suitable for human use and to design machines that are more suitable for the environment. In the process of ergonomic development, changing the way of thinking and adjusting the ideological foundation, accepting the people-oriented optimization consideration, reflecting the interests of people to a large extent, and putting forward the concept of "interaction," it is more intuitive and in line with the development trend of ergonomics. It emphasizes people and extensively considers the "human factor," which refers to various parameters of human growth scale and space in the family environment, strengthens personal psychological factors, and analyzes and designs human-machine interfaces that meet the needs of users. Taking into account the ergonomic design of the environmental space, the personalized design of the space needs to reasonably arrange the model according to the family structure, lifestyle, and regional living habits and adapt to the different needs of the space, and the supervision relationship is relatively independent. Ergonomic design emphasizes the concept of humanization. Because of the difference in family structure and life concept, the concept of humanization is emphasized. It must not only be in line with the overall design thinking of the space but also conform to the people-oriented principle, as shown in Figure 2.

2.3. The Advantages of Ergonomic Home Product Design. Correct use of ergonomics in home products allows for optimal design of home products to meet the needs and wants of people for different groups, different spaces, and different requirements. One is to better define the overall scale of

Figure 2: Four levels of ergonomics.

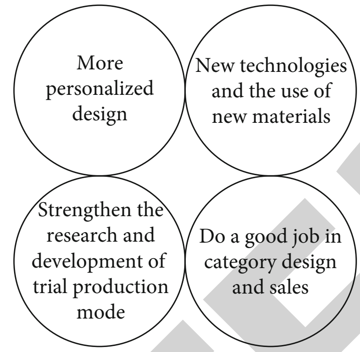

Figure 3: The development direction of ergonomics in interior and furniture design.

household products. Through the use of ergonomics, various household products can be designed to be optimal for human use. By measuring human data, we can calculate the human activity, required activity space, and biomechanics caused by the use of household products and apply the data structure to the design of household products, so that household product users can work in the best way. The design can also reduce unnecessary costs, and by adapting to specific groups of people, it can improve the efficiency of mass production and reduce production costs. Second, in order to give better play to the design effect of home products combined with ergonomics, home products designed on the basis of measurement and calculation can not only give full play to the advantages of interior design but also provide enough space for home products. The ergonomic measurement of home products can compare indoor space data with human body data, integrate reference space and human body data into the design, ensure that product design and interior design are integrated, and realize the integration of interior design, product design, and human body as much as possible. Harmony and unity improve interior space layout and overall furniture coordination through overall design. The overall size of household products can be better determined. By using ergonomics, different household products can be designed into the most suitable state for people to use. The effect of home product design can be better played. Combined with ergonomics, home products designed through measurement and calculation can not only play the advantages of interior design but also ensure that home products have enough space for use and indoor comfort match.

2.4. The Development Direction of Ergonomics in Home Product Design. At this stage, most household items tend to be mass-produced to keep costs down. While this meets people's needs in most cases, it may not meet everyone's needs due to individual differences. Therefore, home product design needs to develop personal design. Therefore, people's specific needs can be met according to personalized design, and the shortcomings of mass production can be compensated for through personalized design. Of course, human-based personalization will significantly increase the cost of design and implementation, but the comfort of designing the same home product will increase accordingly. In order to avoid design problems, furniture designs must be presented and manipulated as intuitively as possible, with flaws found in detail from actual objects. Due to technical reasons and the application of ergonomics in the design of household appliances and household products in my country, the development time is relatively short, as well as the collection of human data and the research and development of pilot production systems; it is necessary to carry out the research and development of pilot production models. Not only can the design quality of home products be improved but also it can give you good feedback after the products are put on the market. In product design, the use of new materials can improve the desired design effect. The use of new technologies and new materials can best meet the design requirements, and the use of new technologies and new materials in production can often provide geometric development space for the practicability and comfort of products. It can also inspire designers to overcome existing limitations by updating technologies and materials to create products that are more comfortable and more responsive to people's psychological and physical needs. Different ethnic groups, different regions, and different age groups in my country have different characteristics, and many situations need to be considered when designing products. Data collection for relevant groups should be done well, and design and sales should be targeted, as shown in Figure 3.

The development directions of ergonomics in home product design in this article are defined:

(1) More personalized design

(2) The use of new technologies and new materials

(3) Strengthen the research and development of trial production mode

(4) Do a good job in classification design and sales

3. Intelligent Algorithm Recommendation

3.1. Coordinated Filtering Recommendation Algorithm. In the neighborhood filtering recommendation algorithm, finding similar users is an important step, and the main goal of similar users is to obtain the most relevant recommended items for the target users. The user-based algorithm is mainly divided into three steps: one is similarity calculation, the other is to select the "nearest neighbor" according to the similarity, and the third is to calculate the point value for prediction and recommendation. The similarity measure looks for users who are "nearest neighbors" and is mainly calculated based on the items being rated. Suppose I_u is the set of items rated by user u, $I_u \cap I_v$ is the set of items rated by users u and v, $r_{u,i}$ is the rating of item i by user u, and $\bar{r}_u$ is the average of the ratings. The following are the most common ways to calculate similarity.

Corrected cosine matching (ACos) was performed, using formula (1) to calculate the matching of user u and user v.

$$\mathrm{sim}(u,v)=\frac{\sum_{i\in I_u\cap I_v}(r_{u,i}-\bar{r}_u)(r_{v,i}-\bar{r}_v)}{\sqrt{\sum_{i\in I_u}(r_{u,i}-\bar{r}_u)^2(r_{v,i}-\bar{r}_v)^2}}. \quad (1)$$

Pearson correlation (PC) was performed, using formula (2) to calculate the similarity between user u and user v.

$$\mathrm{sim}(u,v)=\frac{\sum_{i\in I_u\cap I_v}(r_{u,i}-\bar{r}_u)(r_{v,i}-\bar{r}_v)}{\sqrt{\sum_{i\in I_u\cap I_v}(r_{u,i}-\bar{r}_u)^2}\sqrt{\sum_{i\in I_u\cap I_v}(r_{v,i}-\bar{r}_v)^2}}. \quad (2)$$

Pearson constrained correlation (constrained PC, CPC) was performed, using formula (3) to calculate the similarity between user u and user v. r_{med} is the median of the rating scale.

$$\mathrm{sim}(u,v)=\frac{\sum_{i\in I_u\cap I_v}(r_{u,i}-r_{\mathrm{med}})(r_{v,i}-r_{\mathrm{med}})}{\sqrt{\sum_{i\in I_u\cap I_v}(r_{u,i}-r_{med})^2}\sqrt{\sum_{i\in I_u\cap I_v}(r_{v,i}-r_{med})^2}}. \quad (3)$$

Jaccard computes the Jaccard match between user u and user v using equation (4). $|I_u \cap I_v|$ is the number of items jointly rated by user u and user v.

$$\mathrm{sim}(u,v)=\frac{|I_u\cap I_v|}{|I_u\cup I_v|}. \quad (4)$$

After determining the similarity between the target user's "nearest neighbor" and him, you can calculate the target user's rating for the recommended item and then recommend the position with the highest rating in the recommended item set to the target user. Use equation (5) to predict the target user's score for item i, where sim (u, v) is the similarity between user u and user vi, and N_u is the set of "nearest neighbors" of user u.

$$R_{u,i}=\bar{r}_u+\frac{\sum_{v\in N_u}\mathrm{sim}(u,v)(r_{v,i}-\bar{r}_v)}{\sum_{v\in N_u}\mathrm{sim}(u,v)}. \quad (5)$$

The calculation principle of the item-based algorithm is the same as that of the user-based algorithm, but the calculation object is different, and the user must be replaced by the item.

The recommendation algorithm based on collaborative filtering does not require detailed content. When the details of the content are not accessible or it is difficult to collect or analyze the details, the collaborative filtering method is very effective, and the method can find the item that the target user wants among the massive items. However, it also faces the problem of scoring sparsity, as well as the cold start of new users and new projects.

3.2. Model-Based Collaborative Filtering. In the SVD model, the original rating matrix R is decomposed into three matrices:

$$R = USV^T, \quad (6)$$

where U and V are two orthogonal matrices, S is a diagonal matrix of size $r \times r$, and r is the rank of R, which consists of some values of the fractional matrix. This matrix can be reduced by omitting the minimum value, resulting in a matrix, where $k < r$ and S_k is the decomposed form of the reconstructed matrix:

$$R = U_K S_K V_K{}^T. \quad (7)$$

The scoring prediction formula is

$$R_{u,i} = \bar{r}_u + U_K\sqrt{S_K{}^T}(u)\sqrt{S_K}V_K{}^T(i). \quad (8)$$

3.3. Content-Based Recommendation Algorithm. Currently, the most widely used computational method for information retrieval is the TF-IDF method, which is used to develop vector space models in content-based recommendation algorithms. This method regards the content of item as document d, then extracts keyword t from it, and then calculates the formula for the TF value of keyword t in document d as shown in

$$\mathrm{TF}_{t,d}=\frac{N_{t,d}}{\sum_k N_{k,d}}. \quad (9)$$

Among them, $N_{t,d}$ represents the number of times the keyword t appears in the document d and the calculation of the IDF value corresponding to the keyword t. The formula is shown in

$$\mathrm{IDF}_t=\log\frac{|D|}{1+|d\in D: t\in d|}, \quad (10)$$

where D represents the collection of documents and $1 + |d \in D : t \in d|$ represents the number of keywords t contained in document d.

3.4. CFCNN-CL Algorithm. Calculate similarity between users based on possible "nearest neighbors." There are many ways to calculate similarity, most of which are mainly based on rating positions shared among users in user-provided rating data, which leads to data dilution issues and reduced accuracy.

$$\mathrm{sim}(u, v) = \frac{\max\left(1, |I_u \cap I_v|\right) \sum_{i \in I_u} \sum_{j \in I_v} r_{u,i} / r_{v,j}}{|I_u||I_v||I_u \cup I_v|}. \tag{11}$$

Among them, I_u represents the set of user rating items u, I_v represents the set of user rating items v, $|I_u|$ and $|I_v|$ represent the number of rating items, and $r(u, i)$ represents the rating of item i by user u.

Once the similarity between the target user's "nearest neighbor" you and him is determined, the target user's rating for the item can be calculated. This paper uses formula (12) to calculate the target user's rating value for item i.

$$r_{u,i} = \bar{r}_u + \frac{\sum_{v \in N_u} \mathrm{sim}(u, v)\left(r_{u,i} - \bar{r}_v\right)}{\sum_{v \in N_u} \mathrm{sim}(u, v)}. \tag{12}$$

The common rating items among users in the rating data provided by users will suffer from data sparseness, resulting in reduced accuracy.

3.5. RRP-UICL Algorithm. Rating value prediction is the last important step of the recommendation algorithm. Rating value is predicted by calculating the matching degree of the user's direct "nearest neighbor" with the target user. This paper uses the weighted average method to predict the rating value of a feature item. To recommend an item, a weight must be calculated based on the target user's direct "nearest neighbor" score and the target user's indirect "nearest neighbor" score, and a weight must be used to calculate the score for each item. With the final prediction result, the steps of the prediction method are as follows:

First, the average rating of featured articles needs to be calculated. For recommended items, the average score is calculated according to

$$\bar{r}_i = \frac{\sum_{v \in N_u^d \cup N_u^{id}} r_{v,i}}{\left|N_u^d \cup N_u^{id}\right|}. \tag{13}$$

N_u^d is the direct "nearest neighbor" of user u and N_u^{id} is the indirect "nearest neighbor" of user u. It can be seen from equation (13) that the direct "nearest neighbor" and the intermediate "nearest neighbor" of the target user need to be obtained, and the information is extracted to determine the average score of each feature item.

To predict the ranking of a recommended location, use formula (14) to predict the location score $R_{u,i}$ of the target user u, $r_{v,i}$ represents the location score i of the "nearest neighbor" user v, a is the highest ranking set, and $|r_{v,i} - \bar{r}_i|$ represents the user's "nearest neighbor" v's The average score of position judgment deviation i, $a - |r_{v,i} - \bar{r}_i|^2 - 1$, is the final weight of item i.

$|r_{v,i} - \bar{r}_i|$ denotes the "nearest neighbor" user v's rating deviation from the average rating for item i, and $a - |r_{v,i} - \bar{r}_i|^2 - 1$ denotes the final weight of item i.

$$R_{u,i} = \frac{\sum_{v \in N_u^d} r_{v,i}\left(a - |r_{v,i} - \bar{r}_i|^2 - 1\right) + \sum_{v \in N_u^{id}} r_{v,i} \mathrm{sim}(u, v)\left(a - |r_{v,i} - \bar{r}_i|^2 - 1\right)}{\sum_{v \in N_u^d}\left(a - |r_{v,i} - \bar{r}_i|^2 - 1\right) + \sum_{v \in N_u^{id}} \mathrm{sim}(u, v)\left(a - |r_{v,i} - \bar{r}_i|^2 - 1\right)}. \tag{14}$$

Table 1: Index system of home product design considering ergonomics.

Criterion level one	Criterion level two
Ease of use	Easy to install
	Practical
	Easy to move
	Easy to clean
	Easy to disassemble
	Timely after sale
Safety	Run smoothly
	Structural strength
	Safety fence
	Circuit stealth
	Safe use of materials
	Appropriate size
Aesthetic	Simple shape
	Single color
	Pastel tones
	Home style
	Natural material
	Simple decoration
Feature	Comfort function
	Massage function
	Smart operation
	Purifying air
	Reduce noise
	Convenience function

Table 2: Comparison of the importance of elements in the first level of the criterion.

	Ease of use	Safety	Aesthetic	Feature
Ease of use	1	1/3	5	3
Safety	3	1	7	5
Aesthetic	1/5	1/7	1	3
Feature	1/3	1/5	1/3	1

Table 3: Criterion layer one indicator weight.

	Ease of use	Safety	Aesthetic	Feature	w_i
Ease of use	0.21	0.24	0.30	0.31	0.28
Safety	0.67	0.48	0.48	0.46	0.47
Aesthetic	0.07	0.12	0.12	0.08	0.10
Feature	0.10	0.16	0.16	0.15	0.16

Table 4: Stochastic consistency indicators.

Order	3	4	5	6	7	8	9	10	11	12	13
R.I.	0.583	0.892	1.118	1.243	1.319	1.411	1.446	1.492	1.522	1.539	1.555

3.6. Semantic Differences: AHP. The application of AHP should follow the following two basic definitions:

Set $A=(a_{ij})$. If $a_{ij}>0$, then formula (15) is obtained, which is applicable to any set of i, j. Then, A is called the positive reciprocal inverse matrix. The set of inverse matrices of order n is$M_{p^{n+}}$.

$$a_{ij}=\frac{1}{a_{ij}}. \quad (15)$$

If $A=(a_{ij})$ belongs to $M_{p^{n+}}$, formula (16) is applicable to any i, j, and k. Then, A is called the consistency matrix. The set of n-order consistency matrices is denoted M_{c_n}.

$$a_{ij}=a_{ik}a_{jk}. \quad (16)$$

Use the sum-product method to solve the weights of the indicators of the first criterion layer. The steps are as follows:

Let the judgment matrix be $M=(a_{ij})_{4\times4}$, and normalize the elements in the matrix by column:

$$\bar{a}_{ij}=\frac{a_{ij}}{\sum_{k=1}^{n}a_{kj}} \quad (i,j=1,2,\cdots,n). \quad (17)$$

Row summation of the normalized matrix is

$$\bar{w}=\sum_{i=j}^{n}\bar{a}_{ij} \quad (i,j=1,2,\cdots,n). \quad (18)$$

Find the largest eigenvalue and perform a consistency check. After the element weight data is obtained, it does not mean that the calculation is over. It is necessary to pass the consistency check to prove the validity of the calculation result. The largest eigenroot is

$$\lambda_{\max}=\frac{1}{n}\sum_{i=1}^{n}\frac{(Mw)_i}{w_i}. \quad (19)$$

The consistency index C.I. of the judgment matrix M is

$$\text{C.I.}=\frac{\lambda_{\max}-n}{n-1}. \quad (20)$$

The consistency evaluation index is introduced by Satty, and R.I. is a random consistency index, namely,

$$\text{C.R.}=\frac{\text{C.I.}}{\text{R.I.}}. \quad (21)$$

The basic steps of semantic difference-analytic hierarchy process in intelligent algorithm recommendation are defined as follows:

Table 5: Index weights and ranking of criterion layer 2.

Criterion level two	Weights	Sort
Easy to install	0.063	7
Practical	0.105	4
Easy to move	0.028	12
Easy to clean	0.054	8
Easy to disassemble	0.018	15
Timely after-sales	0.011	19
Run smoothly	0.181	1
Structural strength	0.030	11
Safety fence	0.069	6
Circuit stealth	0.128	3
Safe use of materials	0.173	2
Appropriate size	0.017	16
Simple shape	0.017	16
Single color	0.005	23
Pastel tones	0.010	20
Home style	0.033	10
Natural material	0.025	13
Simple decoration	0.006	22
Comfort function	0.005	23
Massage function	0.071	5
Smart operation	0.036	9
Purifying air	0.023	14
Reduce noise	0.010	20
Convenience function	0.015	18

Step 1. Treat the problem to be analyzed or the solution to be decided as a system.

Step 2. Sort or reorganize the different elements or indicators relevant to the issue or decision.

Step 3. Use the problem to be solved as the target layer and the index or the element as the criterion layer and the scheme layer to construct the hierarchical model.

Step 4. Construct a matrix according to the ratio of two elements at each level.

Step 5. Through the matrix solution and matrix consistency test, the weight of each index is obtained.

Step 6. Make decisions based on weights.

4. Experiment Analysis of Home Product Design and Intelligent Algorithm Recommendation considering Ergonomics

4.1. Ergonomic Home Furnishing Product Design Based on Semantic Difference: AHP. According to the user's needs for ergonomic home product design, the criterion layer is established, and a total of two layers are established. The first

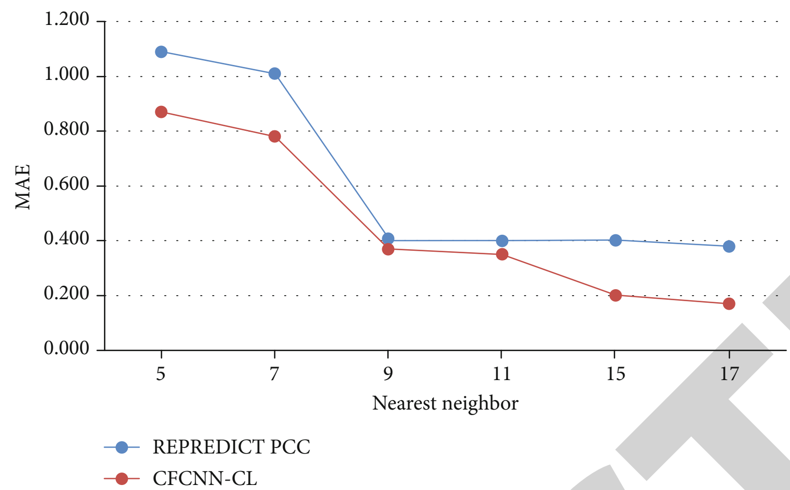

FIGURE 4: MAE comparison of different nearest neighbors.

level of the criterion is functionality, safety, aesthetics, and ease of use; the second level of the criterion is being easy to install, practical, easy to move, easy to clean, and easy to disassemble, after-sales service, stability in operation, structural strength, safety guardrail, invisible circuit, safe use of materials, suitable size, simple shape, single color matching, soft tones, home style, natural materials, simple decoration, comfortable function, massage function, intelligent operation, air purification, noise reduction, and convenient function, as shown in Table 1.

By comparing the importance of the elements of criterion 1, we get that ease of use is slightly less important than safety, ease of use is more important than aesthetics, ease of use is slightly more important than functionality, safety is more important than aesthetics, and safety is more important than aesthetics. Functionality is more important, and aesthetics are slightly more important than functionality, as shown in Table 2.

According to the weight calculation of the indicators of the criterion layer one, the weight of safety is the largest, the weight is 0.47, the weight of aesthetics is the smallest, the weight is 0.1, the weight of usability is 0.28, and the weight of function is 0.16; that is, the safety is in the criterion layer one, which is the most important, followed by ease of use, functionality, and aesthetics, as shown in Table 3.

According to the arbitrary coherence index and formula (21), the matrix coherence judgment index MC.R. = 0.012, C.R.<0.1 can be obtained, so the matrix M satisfies the consistency requirement. Through semantic difference analysis, the layered process of pairwise comparison of four indicators in the first layer shows that safety has the largest proportion in the design of home products considering ergonomics, accounting for 47%, followed by ease of use, accounting for 28%. Again, functionality accounts for 16%, and finally, aesthetics accounts for 10%, that is, safety > ease of use > function > aesthetics, as shown in Table 4.

The importance of the second level of the criterion is stable operation, with a weight of 0.181, followed by safe material use, invisible circuit, strong practicability, massage function, safety guardrail, convenient installation, easy cleaning, intelligent operation, home style, structural strength, being easy to move, natural material, air purification, easy disassembly, suitable size, simple shape, convenient function, timely after-sales, soft color tone, noise reduction, simple decoration, single color matching, and comfortable function, as shown in Table 5.

4.2. Intelligent Algorithm Recommendation for Home Products considering Ergonomics. It can be seen from the figure that the trend lines of MAE and RMSE values of REPREDICT PCC are always above those of CFCNN-CL. The trend lines of CFCNN-CL and REPREDICT PCC both decrease with the increase in adjacent neighbors, so the increase in the nearest neighbors increases the two methods of the accuracy. The CFCNN-CL algorithm has better performance and better accuracy than the REPREDICT PCC algorithm, as shown in Figures 4 and 5.

In the comparison of MAE values of different methods in the dataset, it can be seen that when $N = 5$, the MAE value of UCF-CPC is the largest, and the MAE value of UCF-Jaccard is the smallest; when $N = 10$, the MAE value of UCF-CPC is the largest, followed by RRP-UICL, UCF-ACos, UCF-PC, and UCF-Jaccard; when $N = 15$, the MAE value of RRP-UICL is the largest, followed by UCF-CPC, UCF-ACos, UCF-PC, and UCF-Jaccard; when $N = 20$, the MAE values of UCF-CPC and UCF-PC were the largest, followed by UCF-PC, RRP-UICL, and UCF-Jaccard. In general, the MAE value of UCF-Jaccard is smaller than that of other methods, indicating that this method is less affected by data sparseness, and the change of MAE value is not very obvious, as shown in Figure 6.

In the comparison of MAE values of different methods in the dataset, it can be seen that when $N = 5$ and 10, the MAE value of UCF-CPC is the largest; when $N = 15$, the MAE value of RRP-UICL is the largest; when $N = 20$, the MAE values of CPC and UCF-PC are the largest; the MAE values of UCF-Jaccard are generally smaller than those of other methods, indicating that this method is less affected by data sparseness, and the changes in MAE values are not very obvious.

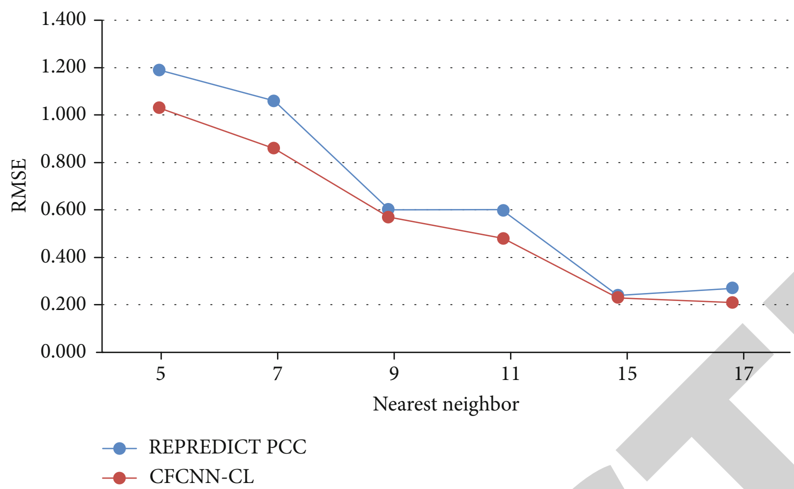

Figure 5: RMSE comparison of different nearest neighbors.

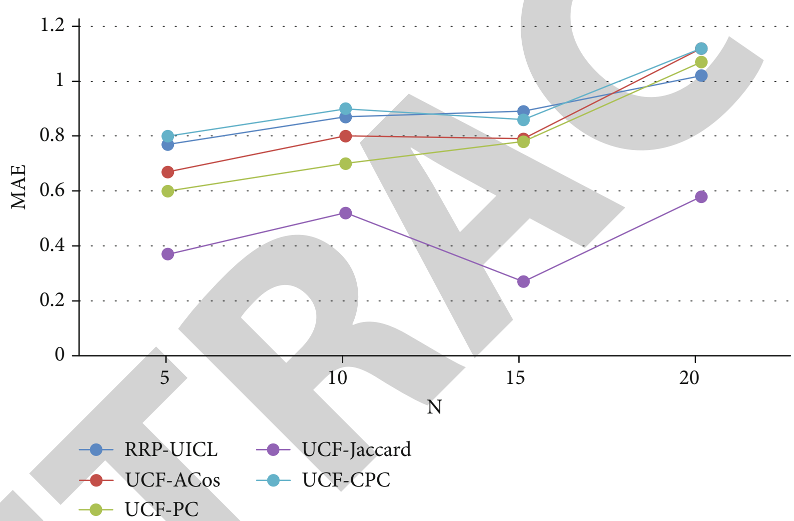

Figure 6: Comparison of MAE values for different methods in the dataset.

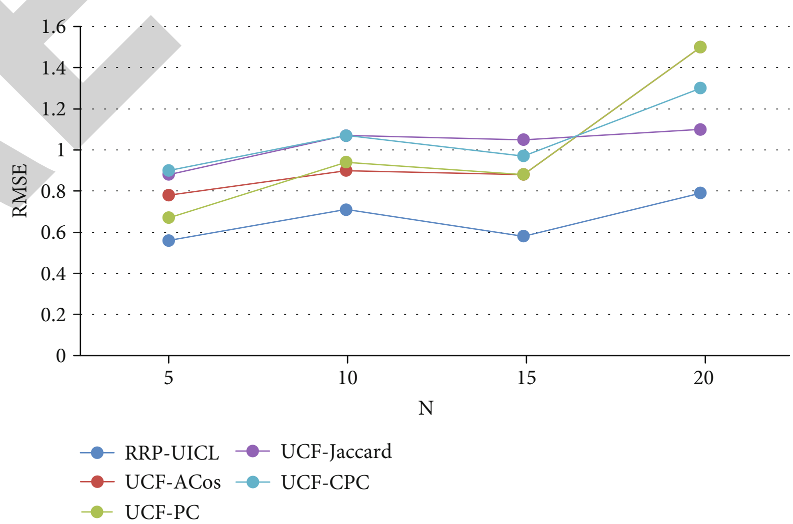

Figure 7: Comparison of RMSE values of different methods on the dataset.

When the sparsity of the dataset increases, the RRP-UICL method still maintains a low RMSE value, while the RMSE values of the UCF-ACos method and the UCF-PC method continue to increase. It can be clearly seen from Figure 7 that the RMSE values of the UCF-ACos method and the UCF-PC method are much larger than those of the RRP-UICL method. The RMSE values of the UCF-CPC method and the UCF-Jaccard method did not increase significantly but were also significantly larger than those of the RRP-UICL method. Therefore, the RRP-UICL method has better prediction accuracy than the commonly used collaborative filtering methods, as shown in Figure 7.

5. Conclusions

The purpose of this article is to examine ergonomic home product design, the product design process, and aspects of design that are closely related to the study of ergonomic design methods. The article starts with the basic theoretical knowledge of ergonomics, combines the actual cases of home space design, uses the theory of human-machine design, conducts product sample design, conducts various design research, obtains relevant data, and further understands the characteristics of modern homes. The product optimization design process provides users with higher-quality products that meet psychological needs and are suitable for human use. The goal of home product design is "people-oriented," people are users, and satisfying users' needs in function, form, and psychology is the focus of product design at this stage. The process of home product design is the process of meeting the internal needs of users, providing users with unique products that meet the individual needs of users, and providing users with tailor-made products, which has gradually become a market trend. In terms of design, ease of use, safety, functionality, and aesthetics are the main requirements for product design, and high quality and high applicability are the assessment criteria for home product design. For the recommendation of the intelligent algorithm, due to the limitations of the current truss construction method concept, the structural performance is low and the time is long, resulting in a slow recommendation speed. Therefore, future work will explore concept network construction algorithms and efficiently construct concept meshes on the original sparse dataset of interest to user elements to improve the performance of the algorithm. Users can also affect contextual information when selecting products, so it is possible to start with contextual information and add user contextual information on the basis of existing methods to improve the accuracy of recommendation.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declared that he has no conflicts of interest regarding this work.

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