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Retraction

Retracted: Profit Information System of Exhibition Enterprises Based on Multiobjective Optimization Algorithm

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Peer-review manipulation

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] Y. Hang, "Profit Information System of Exhibition Enterprises Based on Multiobjective Optimization Algorithm," *Mobile Information Systems*, vol. 2022, Article ID 7898076, 9 pages, 2022.

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Research Article

Profit Information System of Exhibition Enterprises Based on Multiobjective Optimization Algorithm

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To solve the problem of publishing company revenue data, a multiobjective optimization algorithm is proposed. Therefore, based on the research on the multipurpose optimization algorithm, this paper proposed a multipurpose optimization hybrid approval algorithm. The proposed algorithm generates a candidate set through the hybrid recommendation algorithm and then uses the multiobjective optimization algorithm to generate recommendation list with optimal accuracy and diversity. MATLABR2017a was used to calculate the c-metric and hypervolume of the measurement data. Besides, Excel was used to calculate the Pareto solution developed in this paper many times. The test environment is running on 64 bit Win10, running 6 GB memory, and the CPU frequency is 2.30 GHz. Experimental decisions were made by comparing the Pareto optimal solutions developed by the input algorithm and the control algorithm in 3 consecutive groups of experimental users. Experimental analysis shows that Pareto believes that the solution developed by the hybrid approval algorithm is multipurpose optimization, superior to the solution developed by the board, and that the algorithm can be used to create realistic and diverse results.

1. Introduction

The conference and trade exhibition are known as the bread of the city and a fan of the national market. It has a strong driving force, which can not only bring revenue directly to the city such as rent and utilities but also bring revenue such as accommodation, food, communications, commerce, and industry. More importantly, exhibition can gather huge information flow, technology flow, commodity flow, and talent flow, which will exert inestimable influence and catalytic effect on the national economy and social progress of a city or region. The application of information technology in the conference and exhibition industry makes the complex flow of funds, products, and materials in the convention and exhibition activities more smooth, productive, and necessary. Besides, the operating costs of all parties are reduced. As an important supplementary form of physical exhibition, online exhibition has great application value: risk prevention, immediate resolution, good business management for participants and professionals, customer relations maintaining, the extension of electronic commerce value-added services in exhibition industry, etc. In essence, the primary function of exhibition is to spread information, and information technology provides great convenience for transmission, exchange, and processing of information and data. Secondly, exhibition belongs to business activities, while information-based exhibition is the electronization of exhibition business activities. In addition, the performances are usually for revenue purposes, and the performers present the use of information technology in the production process, which includes good at saving, fast, and convenient, and help to achieve high efficiency. Today, the information-based presentation has some role and means that the presentation is always nonexistent. It is not only a means of publicity that has always existed but has also become a new form of presentation, as seen in Figure 1.

2. Literature Review

The informatization of exhibition enterprises is an important corporate philosophy. It is a step-by-step systematic project, which will be established slowly and orderly around

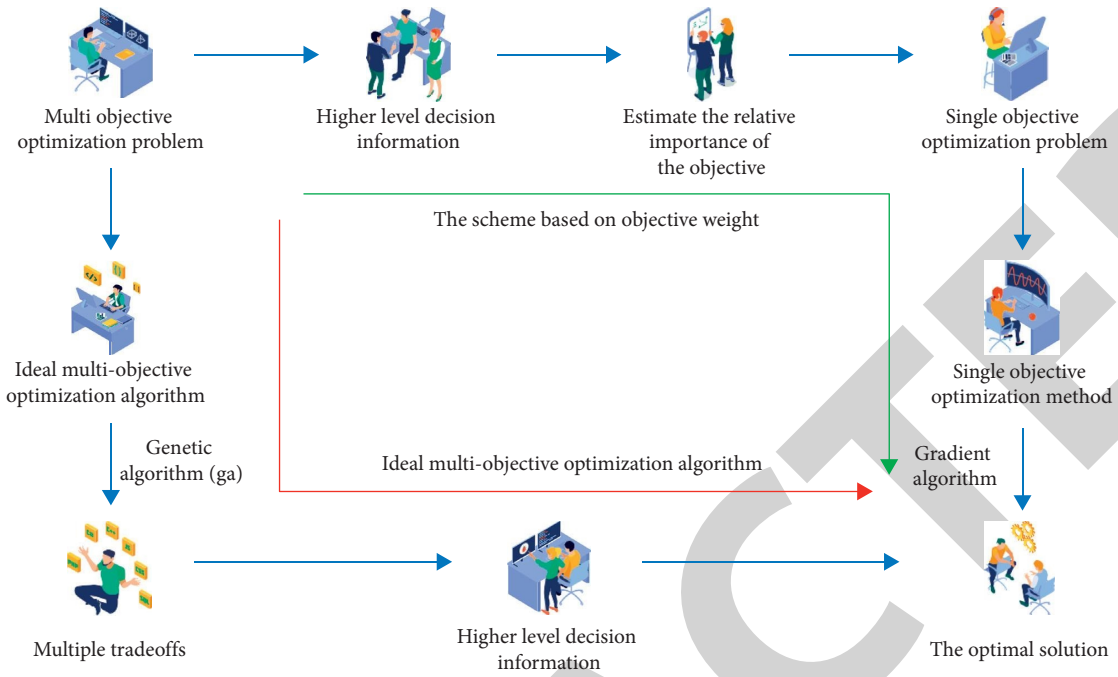

Figure 1: Comparison of multiobjective optimization algorithms.

the value chain and core business of exhibition enterprises. While striving to develop a new development model of "dualization," the exhibition industry, as an important place for product display, communication, and product marketing, is conducive to promoting industrialization and making unprecedented progress. At the same time, due to the development of exhibitions and the variety of exhibition types, how to work effectively and get high financial information can be very important. In recent years, the exhibition industry has developed rapidly, which can drive the industry and trade industry to become an important engine of the industry. Therefore, the intelligent presentation of various conferences should be the main focus, and the digital development of conferences has become a meeting point between the government and the participants' culture. In order to make the exhibition industry transition to the development of the times, the exhibition industry is now developing under the guidance of various informatization and intelligence. Therefore, many exhibition organizers are changing the structure of scientific and technological elements in the exhibition, making it more attractive [1].

Gong et al. [2] discussed the current situation of construction data in the exhibition industry at home and abroad. He put forward the use of RFID technology to complete the construction of performance management and described the composition, function, and characteristics of the technology. He then identified the business requirements for presentation management and developed the entire design process through the use of technologies and applications. He carried out the detailed design and the programming realization to the system function module and achieved the expected goal through the omnidirectional test [2]. Li et al. [3] proposed to build an exhibition network information management system, which can push various information to target customers before the exhibition, provide various convenient services during the exhibition, and provide data analysis support after the exhibition. The system adopts RFID automatic data recording technology to control the process of event planning, online recording of audience information and visitors, demonstration, onsite data storage and management, business data collection, etc. Support for data mining demonstration and decision-making analysis are thus provided [3]. Li et al. [4] applied the use of ASPNET technology to create a management presentation. The implementation methods and development tools of the whole system are introduced. The system can manage exhibitors and visitors [4]. In order to improve the management performance of the demonstration stand, Wu and Chow [5] frequently introduced all the computer-aided designs for improving the demonstration. Among them, RFID technology is conducive to the management of exhibition related items and plays a decisive role in recycling and layout of exhibits [5]. From the inspection, Zhang et al. [6] summarized the ideas and needs of exhibition informatization. In view of the problems encountered in display management, we can think deeply through the characteristics of business model, publishing, advertising, organization personnel, etc., and establish a management information system to help improve the efficiency of exhibition management [6]. In the face of multilevel products, Fathi et al. [7] proposed information management based on B/S architecture, which can meet the needs of multiuser management and can integrate all aspects of exhibition industry to understand the distribution of information management. As a result, the integration of various information provides necessary work decisions for the development of the exhibition industry, thereby enhancing the overall image of the exhibition industry [7]. Li et al. [8]

agreed with the importance of presentation design in the conference presentation industry and utilize the VS2016 development environment to create and develop presentation user management products. The system supports the maintenance of basic information of customers and provides timely exhibition services for customers. Comprehensive management can be conducted to the exhibition projects, and scientific evaluation can be made of the value of exhibitors in order to participate in the pricing of advertising and other aspects of scientific decision-making [8].

According to the current research, a multiobjective optimization algorithm has been designed. After the traditional multiobjective optimization algorithm which transforms the multiobjective optimization problem into single objective optimization problem through certain strategy, scholars at home and abroad seek the idea of solving the multiobjective optimization problem by simulating biological evolution law in nature. Therefore, based on this, scholars have developed a multiobjective optimization algorithm based on intelligent evolution [9].

3. Profit Information System of Exhibition Enterprises Based on the Multiobjective Optimization Algorithm

3.1. Analysis of Profit Model of Exhibition Enterprises

3.1.1. Industry Characteristics

(1) Industrial Economy. The exhibition industry is an industry that promotes trade and relationship interest through work within the industry. Its theme is the presentation and connection of business or information industry, which plays an important role in promoting the success and competition of physical business and industry and promoting the integration of capital and markets. Relying on industrial foundations such as industrial development, conferences, and performances not only plays a key role in capital, trade, exhibition, communication, and sales but also becomes the core of marketing and investment. It also provides a platform for direct communication between enterprise resource elements and the market and at the same time becomes the best place for the generation of new ideas, new concepts, new models, and new trends in the industry. It is generally believed that the exhibition industry has a driving ratio of 1 : 9 to other industries, which is sufficient to show the important role of the exhibition industry in regional economic development. The regional social exhibition industry also has regional characteristics. First, relying on the docking of regional industrial resources and the exchange and exchange center, it will play a strong driving role in regional economic development. Second, exhibition venues are generally large in area, and their social role in the cultural life of urban residents should be fully considered in the construction of venues. In addition to providing professional services, the old theater also has indoor amusement facilities for the convenience of citizens, which has become part of the city's public service practice. Third, the exhibition industry can also serve as a node of urban cultural exhibition. When planning and organizing exhibition activities with cultural characteristics, such as local conditions and practices, it not only enhances the vitality of regional culture and drives the development of cultural industry, but also greatly promotes the development and inheritance of regional culture [10].

(2) Exhibition Industry Chain. The exhibition industry chain usually consists of three links: upstream exhibition management, intermediate exhibition hall management, and downstream exhibition services. Upstream is mainly the planning, development, organization, and release of exhibitions, based only on resources, capabilities, etc. Legacy is capital light and is the most profitable. Mid segment is rental and operating space, modernization, and maintenance areas that feature heavy equipment; on the downside, it includes design engineering services typically related to performance, as well as safety, information, and support services such as support services, as shown in Figure 2.

3.1.2. Main Profit Model of Exhibition Industry

(1) Venue Rental Model. The venue leasing mode is to lease the right to use the venue for profit. At present, this model is mainly used in domestic and foreign exhibition halls. These models have high requirements on the design, quality control, and market potential of cinemas in the industry. The benefits brought by them are generally affected, which interferes with the use value of the projection table. At present, the utilization rate of indoor exhibition halls is generally low. At the end of 2017, the average consumption of the national pavilion was less than 30%, and there were past events. How to improve the utilization rate of the pavilion has become an important problem to solve these models [11].

(2) Organization and Exhibition Model. Organizing enterprises seize the themes with advantages in industrial competition, high-tech and entrepreneurship, and innovation and actively build their own organizational planning and management capabilities. Exhibition projects are developed and organized or self-organized exhibitions with mature operation and self-organized exhibitions or co-organized exhibitions are organized through mergers and acquisitions.

(3) Industry Chain Service Model. Enterprises using this type often involve services in the fields of engineering construction, housekeeping, hotel catering, equipment leasing, transportation, housekeeping, maintenance, etc. The flow of water is at the bottom of the chain and can provide support to the top. Participants and institutions are integrated from benefit from social services, designing or implementing interventions related to the performing arts and the workplace.

3.2. The Construction of Exhibition Value Chain and Analysis of Enterprise Composition

3.2.1. Value Chain Analysis of Exhibition Industry. The trade fair depends on the trade fair and the communication of the products in the trade fair. It has many responsibilities, such

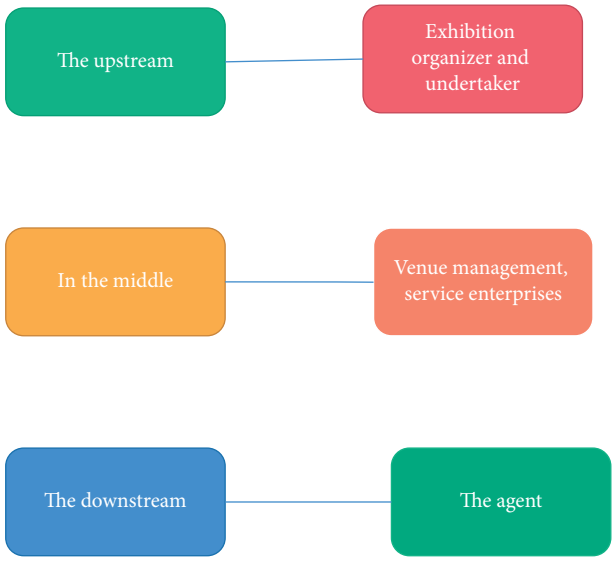

Figure 2: Exhibition industry chain.

as business promotion, exchange, image posting, advertising, and marketing. Of these, the most important task is to promote the industry. Therefore, starting from the capital of the large-scale industry, the profit model of the exhibition industry is studied because industry exhibitions have the role and characteristics of general exhibition, which is representative of some industries. The presentation industry works for other industries as well as the telecommunications industry, so it has the function of integrating the industries of other industries [11].

3.2.2. Analysis on the Structure and Value-Added Process of the Value Chain of Exhibition Enterprises. Although the exhibition industry is dependent on other industries and provides industry services, the exhibition industry itself, as an industry, also has its own industrial chain. The price chain can be divided into four prices. Subdivided by value-added process: presentation of project planning, presentation of business (focusing on advertising and marketing funds), organization and management, and postpresentation analysis. As the main body of exhibition activities, large-scale independent exhibition organization and operation enterprises (business) are the core of the whole value chain of exhibition. Its value-added activities run through the value chain of the exhibition. Whether it is exhibition project planning, publicity, promotion and investment attraction, or on-site activity organization exhibition evaluation, all of them can participate and share the value of the value-added process, and with their absolute dominance in the whole exhibition activities, they canparticipate in all the links of the product value chain enterprises and will have a strong influence. MICE owners here refer to articles, usually referring to the whole process of business participants in planning, developing, organizing, and implementing consulting and presentation services. They play an important role in the coordination of conferences and business presentations and play a key role in planning, promoting, organizing, and advocating for conferences and presentations. They also promote design, development, transportation or business travel, and other participants forcing the lower and middle class to participate in conferences and presentations, creating value, and realize price increases. Other enterprises involved in the value chain are called node enterprises of the value chain, including exhibition venues that provide venue support for the exhibition site and exhibition service enterprises that provide other services for the process of exhibition activities, including exhibition construction and design enterprises, advertising service enterprises, and business travel service enterprises. The main companies and trading companies of the supply chain are interrelated. Companies in the marketplace share the value of referrals to one or more links that share the added benefit of product marketplaces and realize their own interest by providing on-demand services for events including theaters. According to business rules, key enterprises and node enterprises benefit the most from information sharing, division of labor and collaboration, benefit sharing, and joint ventures, in order to achieve the goal of "win-win" [12].

3.3. Functional Architecture of the Information System for Exhibition Enterprises. The exhibition company uses information technology to manage all aspects of the exhibition and provides a platform for information exchange and interaction for organizations, participants, and audiences. Its data management system includes office files, data management websites, and online files. The relationship between us is shown in Figure 3: education office (Information Management Platform for Exhibition Enterprises) is the foundation of exhibition informatization and control. Office information, exhibition site information, and exhibition network information together constitute a comprehensive solution for exhibition information management. The three data should be fully matched and shared [13].

4. Experiments and Research

4.1. Research on Multiobjective Optimization Algorithm. This research focuses on the hybrid approval algorithm based on multiobjective optimization. The problem is abstracted into a multiobjective optimization problem, and then an appropriate multiobjective optimization algorithm is used to solve it. Various objective optimization algorithms: in recent years, the optimization problem has become a problem in engineering practice and research, and many algorithms are the ultimate optimization problem, especially the most popular deep learning algorithms for machine learning. Optimization problems: multiobjective optimization problems can be solved by a high-cost process in high math while comparing all objective values. When another objective, one solution will have a better purpose worthwhile. The effect is even worse. Therefore, in the process of measuring the solutions developed by various objective optimization algorithms, a compromise solution, known as the Pareto optical solution or no solution, has been recognized. Multipurpose optimization of each problem

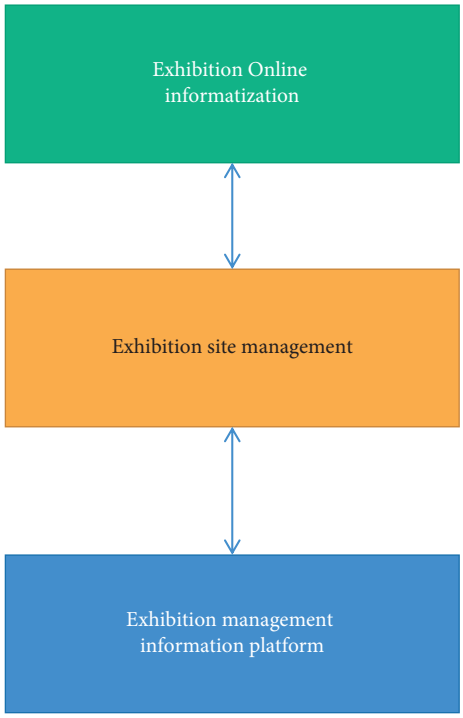

Figure 3: Exhibition information management system.

usually yields various nonsolutions. The standard procedure for solving a multiobjective optimization problem is to weigh several objectives and turn it into an objective optimization problem, but in many aspects of multiobjective optimization, there is no relationship between the objectives. In addition, it is useless to calculate optimization problems with multiple objectives by weights because each weight can produce a similar solution, and a well-solved problem can only be obtained by adjusting the weights. The genetic evolution of natural diseases: after genetic coding and population initiation of the problem, the solution is continuously modified by applying the mutation process in genetics to keep the modified solution in the direction of optimization. The research shows that intelligent evolutionary computing (IED), as a global optimization algorithm, has the characteristics of high robustness, adaptability, and self-learning. Currently, evolutionary algorithms are often used to solve problems with multiple optimization objectives. In recent years, many scientists have developed multiobjective optimization algorithms, using evolutionary algorithms to solve multiobjective optimization problems [14]. The first generation of evolutionary multiobjective optimization algorithms is characterized by the integration of multidisciplinary common inputs. Mechanism and self-selection method: according to Pareto sorting, the second-generation evolutionary multiobjective optimization algorithm characterized by an elite holding mechanism, more self-developed multiobjective evolutionary algorithm source codes have been developed [15].

4.2. Mathematical Description of Multiobjective Optimization Problems. Multiobjective optimization problems usually require simultaneous optimization of multiple objective functions under one or more constraints. A typical multiobjective optimization problem can be expressed as

$$\left\{\begin{array}{lll} \min & y = F(x) = (f_1(x), f_2(x) & \\ \text{S.t.} & g_i(x) \le 0 & i = 1.2, \\ \text{s.t.} & hj(x) = 0 & j = 1, 2. \end{array}\right\}. \quad (1)$$

Among them, $x = (x_1, x_2, x_3)$ e X c Rn is an n-dimensional vector, $y = (y_1, y_2, y_m)$ e Y c Rm is an m-dimensional target vector, X is determined in an n-dimensional space, Y is the m-dimensional space; and $F(x)$ is the set of targets, representing m functions that map from order locations to target locations. The formula $g_i(x) \le 0$, $i = 1, 2, q$ and the formula $h_j(x) = 0$, $j = 1,2$ correspond to the constraints of the problem; so, in this context, different kinds of objective optimization algorithms have shown many terms in the field.

4.3. Traditional Multiobjective Optimization Algorithm. Multiobjective optimization algorithms are tools for solving engineering problems and scientific research. In recent years, more and more domestic and foreign scientists have joined the research team, which makes many multiobjective optimization algorithms emerge one after another. The basic premise of the multiobjective optimization algorithm is to convert the multiobjective optimization into an objective optimization algorithm, which is the basis of the multiobjective optimization algorithm.

Development of multiobjective optimization algorithms: representatives of traditional multi-objective optimization algorithms are as follows [16].

4.3.1. Weighted Summation Method. The weighted summation method is a traditional method to solve multiobjective optimization problems. The algorithm idea is to assign weights to each objective function in advance. Then, the fitness of each objective function is accumulated by the weighted method, and the multiobjective problem is transformed into a single objective problem, and the final cumulative value is used to represent the target value. This can be translated into formulas (2) and (3) according to the constraints:

$$\min: f(x) = w_1 \bullet f_1(x) + w_2 \bullet f_2(x), \quad (2)$$

$$\text{s.t.} w \ge 0 \quad (i = 1, 2, m). \quad (3)$$

Through the weighted sum method, many objective optimization problems can be transformed into a very complex mathematical problem. However, it has the characteristic of being unreliable, the weights will hinder the setting of the weights in the first place, but the setting of the weights is a heuristic, not a rule to follow. Subjectively, it is determined by the importance and knowledge of each target value in a particular situation, which is very difficult. The vector weight set corresponds only to unmarshalling, which is inefficient [17].

Moreover, there is no necessary relation between the weight parameter and the value of the solution. Sometimes significant changes in weight parameters may lead to similar solution vectors, while sometimes small changes in weight parameters may lead to significant changes in solution vectors. However, this approach does not work for all multiple optimizations target problem. When a problem can be turned into a convex operation, Pareto sees a solution that can be repeated in this way. However, this approach does not guarantee a solution if the problem cannot be transformed into a convex function [18].

4.3.2. The Constraint Method. In this algorithm, one subobjective is selected as a new optimization objective, other subobjectives are converted into constraints within various scales specified by the user, and many nondominated solutions are obtained by changing the starting point of the limit many times. Its mathematical description is

$$\min = y = f(x) = f_k(x), \quad 1 \le k, \tag{4}$$

$$\begin{aligned} \text{s.t.} \quad & f_i(x) \ge \varepsilon_1 \quad 1 \le i \le m, \\ & g_i(x) \le 0, \quad i = 1, 2. \end{aligned} \tag{5}$$

Among them, yogi is the user's restriction on target function startup. In the process of finding the optimal solution, the entire Pareto vision solution is explored by adjusting the value of ε_i. This model is similar to the weight measurement method, which also uses heuristics and proprietary techniques to modify ε_i, but the restriction method is more efficient for measuring weights in nonconvex solutions [19].

4.3.3. Goal Programming Method. The main idea of the algorithm is to find the best resolution for each function objective, $f_i(x^*)$, $1 \le m$ with some inputs, and then learn more optimization objectives by computing the following:

$$F(x) = \sum_{i=2}^{n} \left[\frac{f_i(x) - f_i(x^*)}{f_i(x)} \right]. \tag{6}$$

The algorithm focuses on the optimal $f_i(x^*)$ resolution for each work object. Compared to the previous weighted sum algorithm and limit method, adjusting the weight and limit initialization requires the knowledge of the doctor. The target programming method does not require human intervention, making the algorithm more controllable.

4.4. The Experiment. In order to study the proposed hybrid algorithm based on multiple optimization objectives, this experiment is performed using the open-source NSGA-II source code and the hybrid recommended multipurpose optimization algorithm. Much of the entire process is written in C++. libMF is an open matrix factorization library developed in the lab, known as *R*, that uses matrix factorization [20] to obtain test scores. In this experiment, MATLABR2017a is used to calculate the measurement methods of C-Metric and Hypervolume, as well as the performance. Multiple randomly generated Pareto solutions are counted by Excel. The test environment is a 64 bit Win10 operating system, running 6 GB of memory, and the CPU frequency is 2.30 GHz. The programming environment is the Visual Studio 2013 integrated development environment [21].

4.4.1. The Experiment Design. In this experiment, in addition to the practice of developing a hybrid approval algorithm based on multiple optimization objectives, three control group experiments are also developed. The specific process of the control experiment is shown in Figure 4. Compared with the traditional hybrid algorithm based on multiobjective optimization, the "led union set" fusion method is adopted, and a consensus candidate set is generated for the next job setting candidates through various consensus algorithms. In the procedure of selecting a single recommendation algorithm in the control experiment, this experiment adopts the user-based collaborative filtering recommendation algorithm, the object-based collaborative filtering recommendation algorithm, and the matrix decomposition algorithm, respectively [22].

The experimental group is optimized based on hybrid recommendations using multiple targets: for each user, candidate recommendations from the user are received. Using ensemble filtering, the fusion mode develops material "lead and union" based on joint filtering and matrix factorization to create an optically compatible candidate set of length H ($C \le H \le 3C$). Subsequently, a final agreement of length L is selected with a candidate consensus setting using the multiobjective optimization algorithm NSGA-II. The project's management team uses a common view algorithm based on multiple optimization objectives: for all users, the user-based ensemble consensus algorithm, shared consensus algorithm, and matrix factorization algorithm are typically used to generate candidate proposals of length C and then use the multiobjective optimization algorithm NSGA-II to select nominees of length L per client. Then the multi-objective optimization algorithm NSGA-II is used to select the recommendation list of length L from each recommendation candidate set [23].

The results of this experiment are written in C++. The data model of a system typically uses arrays, pointers, and models. The special file design pattern is shown in Table 1.

In addition, all data used in the experiments are read into the system in the form of data. During the stage of using the matrix factorization method, *R* calls libMF to open the library to create the matrix factorization estimate score. At user-based ensemble filtering and product-based ensemble filtering algorithms, user matrices and product-based matrices are generated by working in C++ and stored by a data matrix. On this basis, the user scores of the videos created by the two algorithms are estimated from the score data. In the test set, we will get estimates created by the three algorithms from an "ensemble," fuse the model for a mixture of competitors to the ensemble, and then use the coding problem described in this chapter for the capabilities and limitations of the NSGA-II algorithm. Sex is selected through a combination of consensus candidates that build diversity, while also being optimally certified. In the board,

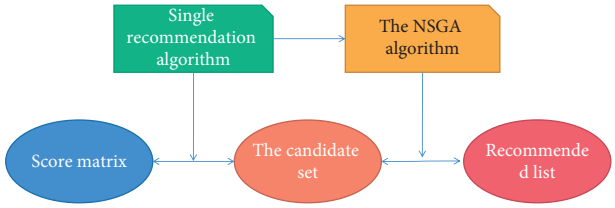

Figure 4: The framework of the comparative experimental algorithm.

Table 1: Outline design of the structure of experimental data.

Data structure type	Data description
Structure	Grading records
Array	User-user similarity matrix
Guide	So structure and data definition
Common variables	Parameters required by the algorithm

the candidates obtained by our approved algorithms generally receive the coding methods, constraints, and expected operations described in the previous chapter and use the NSGA-II algorithm to select from the candidates with consistent diversity and accuracy name's similar proposal, similar to three different control panels [24].

4.5. The Experiment Result. For different users in the test case, different recommendation lists are generated, which is the optimal Pareto solution set in the second stage. Therefore, in the stage of analyzing the test results, we randomly selected three consecutive numbers from the test process: user 290 for user 292. The purpose is to compare the merits and demerits of the hybrid recommendation algorithm based on multiobjective optimization and Pareto solutions generated by other comparative experiments. Among them, hybrid is a multipurpose optimization hybrid consensus algorithm proposed in this paper during user-based, product-based, and MF controlled experiments. It is most similar to multipurpose optimization combined with user-based integrated filtering and approval algorithm: product-based integrated filtering approval algorithm and multipurpose optimization combined with matrix factorization algorithm.

The goal of the multipurpose algorithm optimization in this paper is to reduce the accuracy and diversity of recommendations simultaneously, such as reducing both f_1 and f_2. Med represents the mean of the smallest f_1 values (f_2) of the Pareto solution from 30 random trials. Mean represents the mean of the smallest f_1 values (f_2) of the Pareto solution from 30 random trials, and Std represents the smallest value the Pareto solution f_1 (f_2) values generated by the difference of 30 random trials which are shown in Table 2.

In Table 2, the median, mean, and variance of minimum f_1 values in each round of 30 random tests for the experimental group and the control group by test users no. 290–293 are calculated. As can be seen from Table 2, in fact, for all 3 groups of test users, the minimum value f_1 value of the Pareto set obtained by our multipurpose optimization

Table 2: The median, mean, and variance of the minimum f_1 (accuracy) value of the test user.

Users' ID		User-based	Item-based	mf
290	Med	0.756	0.896	0.703
	Mean	0.896	0.569	0.126
	Std	0.229	0.852	0.129
291	Med	0.260	0.896	0.236
	Mean	0.356	0.126	0.589
	Std	0.236	0.586	0.896
292	Med	0.789	0.756	0.457
	Mean	0.546	0.723	0.963
	Std	0.123	0.456	0.256

mixed approval algorithm is the least among the 30 rounds of random test mean and minimum mean. This further shows that the hybrid approval algorithm based on multi-objective optimization is more correct than the other three groups of single-machine algorithms based on multi-objective optimization. For the difference of the minimum f_1 value in the Pareto set, the experimental results are not the same. For experimental user no. 290, the multipurpose optimization algorithm combined with matrix factorization yields the smallest difference. The multiobjective optimization algorithm of user experiment no. 292 and the multiobjective optimization algorithm combined with the product-based integrated filtering algorithm has the smallest difference. While for other groups of user experiments, the average variance objective of the hybrid approval algorithm based on multiple optimization is the smallest. It shows that the accuracy of Pareto solution generated by the hybrid recommendation algorithm based on multiobjective optimization is relatively stable during multiple tests.

Figures 5 and 6 roughly show the Pareto solution for the user of this experiment nos. 290 and 291 at the same time; the abscissa represents the f_1 value corresponding to the Pareto solution, and the ordinate represents the equivalent f^2 value of the Pareto solution. Hybrid recommendation algorithm based on multiobjective optimization (hybrid), multipurpose optimization algorithm combined with user-based integrated filtering algorithm (user-based), multipurpose optimization algorithm combined with product-based integrated filtering algorithm (product Based), and marked in Pareto solutions developed in randomized experiments combining a multipurpose optimization algorithm with a matrix factorization algorithm (MF), the Pareto solution set generated by a random test, are marked in the figure, respectively. As can be seen from the figure, the Pareto solution obtained by the hybrid consensus algorithm as a multiobjective optimization is located in the upper left corner of the integral of all solutions as a whole, which is shown compared to our other groups. In contrast to experiments, the procedure described in this paper can yield smaller values of f_1 and f_2.

The experimental decision was made by comparing the Pareto of the best solution developed by the input algorithm and the control algorithm among three groups of users. The experimental experiments showed that the Pareto saw the solution developed by the hybrid consensus algorithm based

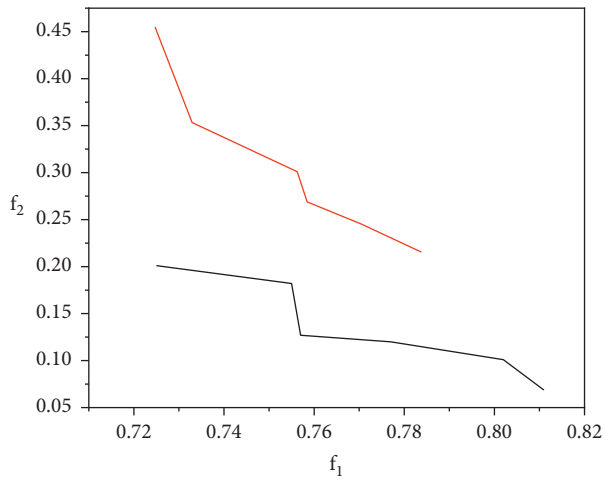

Figure 5: The Pareto solution set of no. 290 user.

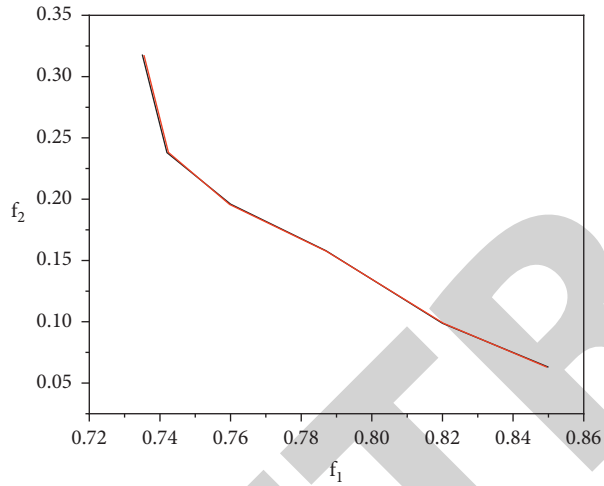

Figure 6: The Pareto solution set of no. 291 user.

on multiple objectives. Program: the optimizations planned in this paper outperform those created by the management team, and the algorithm can be used to create the best and most diverse protocols.

5. Conclusion

This paper studies a hybrid recommendation algorithm based on multiobjective optimization, and develops a multiobjective optimization model with clear and diverse perspectives for this problem. Specifically, it is divided into two parts: the part generating recommendation candidate set and the part generating recommendation list. In the module generating recommendation candidate set, the user-based collaborative filtering recommendation algorithm based on item collaborative filtering recommendation algorithm and matrix decomposition are, respectively, used to obtain the corresponding recommendation candidate set. On this basis, the recommended candidate set is fused to the mixed candidate set by the fusion mode of *union set*. In the module of generating the recommendation list, the problem of selecting the recommendation list with optimal accuracy and diversity from the candidate set is abstracted to a multiobjective problem. The nondominated sorting algorithm NSGA-II, which retains the elite strategy, is used to obtain the final Pareto optimal solution.

Data Availability

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

Conflicts of Interest

The author declares no conflicts of interest.

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