Spring Research on the Design of Human Resources Management System for Property Companies Based on Cloud Framework

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Abstract—**Enterprise human resources management faces problems such as improper service matching and inadequate management. In order to solve the problems in traditional human resource management, an intelligent human resource management platform is designed based on the Spring Cloud framework. Firstly, for the problem of insufficient human resource matching, an improved hybrid genetic algorithm based human resource recommendation model is proposed, which ranks job seekers through collaborative filtering. At the same time, the improved hybrid genetic algorithm is used to optimize the ranking weight and improve content recommendation. A human resource scheduling method considering resource balance is proposed for work scheduling problems, and scheduling solutions are solved using branch definition method and heuristic method. In the experimental analysis of human resources recommendation, the root mean square error and mean absolute error of the proposed model were the lowest among the three, which were 0.013 and 0.07 3 respectively. In the comparison of recommendation accuracy, the proposed model performed best in both management positions and service positions. The recommendation accuracy was 0.982 and 0.976 respectively, which was better than other models. In the experimental analysis of manpower scheduling, the designed model has the best optimization results among the three scheduling models. Finally, the scheduling solution for Project A is carried out. Both solutions can reduce the project duration and meet the needs of the enterprise. The research content provides important technical support for the scheduling management of enterprise human resources and information construction.**

Index Terms—**branch and bound method, collaborative filtering, human resource scheduling, hybrid genetic algorithm, spring cloud framework**

I. Introduction

HUMAN resource management plays a vital role in various industries, and the property industry, as a field full of human-intensive work, is particularly important for human resource management. The Spring Cloud framework is an open source micro service framework with the characteristics of high scalability, strong fault tolerance, easy deployment and maintenance [1]. The framework provides a rich set of components and tools to help developers quickly build distributed systems. In property human resources management, a platform based on the Spring Cloud framework can realize the interconnection of multiple modules and improve the reliability and efficiency of the system [2]. Considering that traditional human resource management technology relies too much on manual experience and rules, it cannot fully utilize data for intelligent decision- making. Therefore, a human resources recommendation model and a human r6esource scheduling model were designed under the Spring Cloud framework to match job seekers with suitable positions through a combination of collaborative filtering and genetic algorithms [3]. At the same time, a combination of branch bounding methods and heuristics are used to optimize work scheduling. The innovation of the research is to develop a human resources management platform based on the Spring Cloud framework to achieve multi-terminal and multi-service solution deployment. At the same time, for traditional human resources management, the intelligent management model is integrated to significantly improve the effectiveness of human resources management. The research content will provide technical guidance for property human resources management and information deployment.

The research content is divided into four parts. The first part mainly analyzes and discusses the Spring Cloud framework and the latest related technologies of human resource management; the second part builds a human resource management model based on the Spring Cloud framework, including a recommendation model and a human resource scheduling model; the third part The third part is to apply the mentioned technology to specific scenarios and verify the application effect of the recommendation model and scheduling model in actual scenarios. The fourth part summarizes and analyzes the full text and elaborates on the improvement direction of the research.

II. Related Work

The Spring Cloud framework is an advanced micro service framework with more mature application scenarios and outstanding advantages in service construction and problem handling. Padma Latha VL and others found that in Spring Cloud-based software services, the gateway is regarded as the entrance to various services and must perform a rate limiting process, which affects system stability. To solve this problem, the study proposes an overload protection technique that relies on Uniform Resource Identifier profiles and a gateway that can filter requests before obtaining a token. In specific experimental scenarios, the proposed technology has excellent performance and security performance and meets

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system service requirements [4]. In their research, Yang proposed an online ordering system based on the Spring Cloud framework to meet urban dining-related service requirements. Among them, the system adopts a development model with front-end and back-end separation. The front-end uses the popular vue.js framework technology. At the same time, the back-end part of the system adopts the spring cloud micro service architecture. The entire system service includes four major services: account service, menu service, order service and user service. Applying this platform to specific scenarios not only expands the scope of services, but also greatly improves the efficiency of user ordering [5]. Erdenebat and others studied the service discovery mechanism of Kubernetes and conducted related experiments on Spring Cloud framework services. In large-scale Kubernetes clusters, it is necessary to ensure the effectiveness of system services, requests, and workloads. But an increase in the number of service requests often leads to resource utilization errors. In this regard, in order to solve this problem, the system service performance and scalability were studied, and a system optimization strategy was proposed to solve the resource utilization problem. Through relevant experimental analysis, it was found that the proposed technology can effectively reduce service request errors, and at the same time, system delay and resource utilization issues have been effectively improved [6].

Machine learning technology has important applications in human resources management service systems and can provide important technical support for corporate talent management based on user characteristics, corporate needs and behavioral data. In order to solve the demand matching problem of the traditional human resources platform, Vrontis and others improved the existing system platform, introduced new resource scheduling strategies, and added multi-functional target sections to achieve human resource scheduling optimization through a collaborative scheduling mechanism. Applying the proposed technology to specific scenarios, the proposed technology has excellent performance and improves the scheduling effect of human resources [7]. In order to improve the intelligence of existing human resources management, Stroh Meier refers to the general literature on digital organizations, and the terms and types of digital human resource management are given, and the relevant concepts and goals of digital human resources are defined. At the same time, in the research, advanced machine learning is applied to the human resources digital service system to significantly improve the enterprise's human resources management and scheduling effect by matching resource scheduling with personalized needs. Through experiments, it was found that digital technology can improve the coordination effect of human resources services, optimize resource organization, and improve the overall management effect of the enterprise [8]. In order to optimize the human resource scheduling problem, Garg and others used machine learning to train the human resources system, which can dig deeper into resources and match relevant services according to enterprise needs, thus simplifying the human resources management process. Through the above research, important opinions will be provided for the integration and improvement of human resources [9]. AL Hamad and others conducted a study on the impact of human resource management on organizational health. Through questionnaire surveys and related experiments, they found that the improvement of human resources can significantly affect employees' work performance and at the same time have a positive impact on the development of enterprises. In this regard, a human resources recommendation technology is proposed to improve human resources services. This technology considers employees' emotional needs and uses collaborative filtering technology to match relevant features to optimize system resource management strategies. Relevant experiments show that the proposed technology can improve the human management efficiency of enterprises and increase the attraction of talents, which is of great significance to enterprise management [10-11].

According to the above research, it can be seen that the Spring Cloud framework and machine learning technology have important applications in human resources management, with strong adaptability and good service processing effects. However, the above-mentioned research mainly focuses on the optimization of human resource service needs, and there is less research on the matching and scheduling of human resources. Therefore, a human resources management model is built based on the Spring Cloud framework to improve the management effect of the human resources system.

III. Construction of Property Human Resources Management Model Based on Spring Cloud Framework

This part mainly introduces the human resources system based on the Spring Cloud framework. On the basis of the traditional human resources management system, a human resources recommendation model and a human resource scheduling model are constructed respectively to complete the intelligent management of human resources.

A. Construction of Human Resources Recommendation Model Based on Hybrid Genetic Algorithm

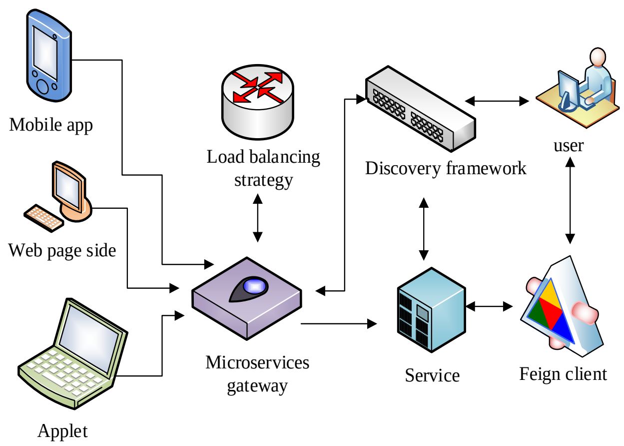


Fig. 1. Intelligent property human resource service framework.

Human resource management is one of the most important tasks in the development of enterprises, including recruitment, job scheduling, and employee training. In order to efficiently manage property human resources, an intelligent property human resource management platform was designed based on the Spring Cloud framework. At the same time, deep learning technology is used to design two human resource management models on this platform, including a human resource recommendation model and a human resource scheduling model, in order to complete the screening of human resource talents and efficient scheduling of work tasks. The entire intelligent property human resource service framework based on the Spring Cloud framework is shown in Fig. 1 [12].

As shown in Fig. 1, the platform can provide human resource management services through mobile terminals, PC web terminals, etc. In the system design, for the human resources service matching problem, a human resources recommendation model based on an improved hybrid genetic algorithm was proposed. First, the study defines a scoring function for job seekers to assess their preference for different resources. Suppose there is n_r a job seeker and m_r job resources [13]. The study uses a matrix R to represent the company's rating of the job seeker, which $R_{i_r j_r}$ represents the company's rating between the job seeker and the resource [14]. j_r the goal of the research is to predict unknown ratings to recommend the most suitable job search resources for companies. In order to calculate job seeker ratings, the research uses collaborative filtering method. Collaborative filtering can use the similarities between job seekers to make recommendations [15]. The study used a user-based collaborative filtering approach to filter out the final score by calculating similarities between job applicants. Specifically, the study used cosine similarity to measure similarity between job applicants. Assume that i_r the similarity between job seekers s_{ij} and job seekers j_r, the formula can be expressed as Equation (1)

$$s_{ij} = \frac{\sum_{k=1}^{m_r} R_{i_r k} R_{j_r k}}{\sqrt{\sum_{k=1}^{m_r} R_{i_r k}^2} \sqrt{\sum_{k=1}^{m_r} R_{j_r k}^2}} \tag{1}$$

Based on candidate similarity, research can match ratings between candidates and resources for businesses. Suppose the study wants to predict job seekers' ratings of i_r resources j_r, denoted by $\hat{R}_{i_r j_r}$. In the study, i the similarity between job seekers and other job seekers was weighted and averaged to obtain j, a predicted score expression for resources, as shown in Equation (2).

$$\hat{R}_{i_r j_r} = \frac{\sum_{k=1}^{n} s_{i_r k} R_{k j_r}}{\sum_{k=1}^{n} |s_{i_r k}|} \tag{2}$$

Next, the optimal weight value is searched through the global search capability of the genetic algorithm to obtain a classification model for human resources recommendations [16]. The study regards resource recommendation as a two-classification problem, that is, resources are divided into two categories: recommended and not recommended, and the human resources recommendation results are obtained through the top scores. Research uses base classifiers in ensemble learning to classify resources, where each base classifier has a set of weight values [17]. Assume that the study has a base classifier, and the weight vector of each base classifier is expressed as shown in Equation (3).

$$\mathbf{w}_s = (w_{s1}, w_{s2}, ..., w_{sm}) \tag{3}$$

In Equation (3), $s = 1, 2, ..., N$. The study uses a genetic algorithm based on particle swarm optimization to search for the optimal weight vector. Genetic algorithms find the optimal solution by continuously iterating the evolution process and optimizing the fitness function. The research goal is to maximize the accuracy of the classification model [18]. Assuming that the fitness function of the study is $f(\mathbf{w})$, indicating the accuracy of the base classifier, the study uses particle swarm optimization to iteratively calculate the optimal weight vector. First initialize a group of particle swarms, as shown in Equation (4) [19].

$$\mathbf{w}_s = (w_{s1}, w_{s2}, ..., w_{sm}), \quad s = 1, 2, ..., N \tag{4}$$

In Equation (4), w_{im} represents any particle in a group. The study randomly generates an initial weight vector for each particle and calculates its fitness. Then, through the iterative optimization process, the weight vector of the particles is continuously updated until the optimal solution is reached, which is the optimal weight vector of the genetic algorithm. In each iteration, in order to avoid the genetic model falling into local convergence during the search process, a simulated annealing operation is used to improve the randomness of the search. In addition, an adaptive crossover operation is introduced to dynamically adjust the crossover probability and improve search efficiency. The principle diagram of adaptive crossover is shown in Fig. 2.

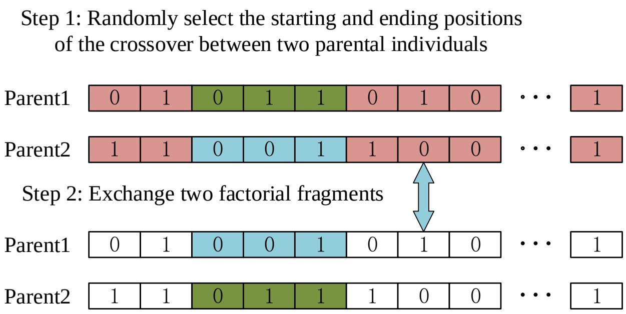


Fig. 2. Schematic diagram of adaptive crossover operation.

The adaptive crossover operation can dynamically adjust the crossover probability according to the fitness of the current population. Specifically, the crossover probability is defined p_c as, and the calculation expression is as shown in Equation (5).

$$p_c = \frac{1}{N_o} \sum_{s=1}^{N} \frac{f(\mathbf{w}_s)}{\sum_{s=1}^{N} f(\mathbf{w}_s)} \tag{5}$$

In Equation (5), N_o represents the size of the population and $f(\mathbf{w}_s)$ represents the fitness of the th individual. Assume that in the first iteration, the optimal weight vector studied is $\mathbf{w}_{opt}^{(t_d)}$, and its fitness is $f(\mathbf{w}_{opt}^{(t_d)})$. The study uses simulated annealing operation to update the optimal weight vector, and its update formula is shown in Equation (6).

$$\mathbf{w}_{opt}^{(t_d+1)} = \mathbf{w}_{opt}^{(t_d)} + \sigma \cdot \Delta \mathbf{w} \tag{6}$$

In Equation (6), σ represents the step size of simulated annealing and Δw represents the weight change at the current temperature. Through the above simulated annealing operation and adaptive crossover operation, the research can continuously update the optimal weight vector during the iterative process of the genetic algorithm until the optimal solution is reached. The entire human resources recommendation model is constructed as shown in Fig. 3.

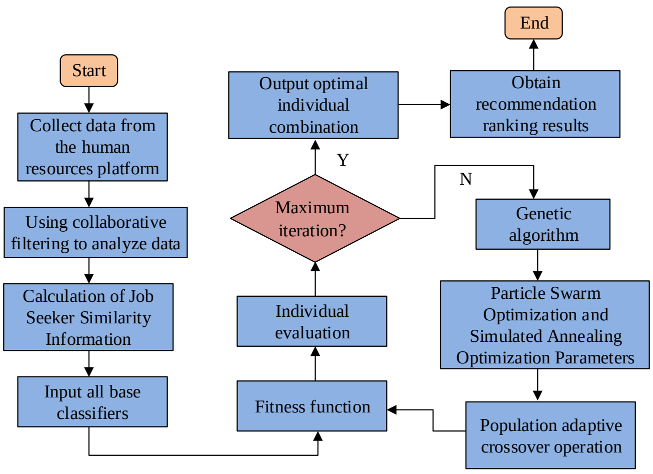


Fig. 3. Schematic diagram of the human resource recommendation model process.

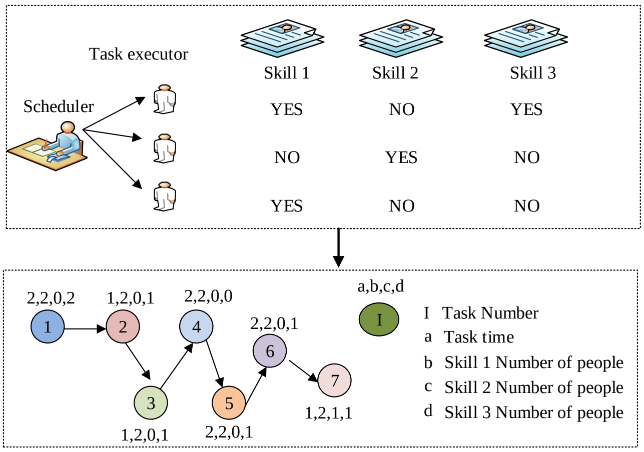


Fig. 4. Schematic diagram of task scheduling for property personnel.

B. Construction of Human Resource Scheduling Model Considering Resource Balance

In the actual management of property human resources, due to the large content of property management work, an employee may handle multiple tasks in a day, and different process arrangements will directly affect the progress and effect of the work. Therefore, in view of the work scheduling problem of property staff, a human resources scheduling model is designed under the Spring Cloud framework to solve the work scheduling problem of property staff through the human resources scheduling model. The schematic diagram of property task scheduling is shown in Fig. 4.

In Fig. 4, real estate task arrangement will give priority to whether employees are qualified for the task. The skill attributes of employees will determine the arrangement and scheduling of work tasks, thereby affecting the overall completion effect of the task. Define the construction period target of a certain property work task as f_1, then the expression of the construction period is as shown in Equation (7).

$$f_1 = \sum_{t=ES_n}^{t=LS_n} x_n^t \cdot t \tag{7}$$

In Equation (7), Ls_n represents the latest time of an activity and Es_n represents the earliest start time of an activity. x_n^t indicates that an activity t starts at a certain time. The property resource scheduling objective is defined as f_2, and its expression is shown in Equation (8).

$$f_2 = \beta \times LD_r + (1-\beta) \times LD_t \tag{8}$$

In Equation (8), β represents the weight coefficient, LD_r represents the balance degree of human resource workload. The smaller the value, the more balanced the human resource scheduling is, as well as LD_t, the distribution of human resource demand. The smaller the value, the more balanced the human resource scheduling is. The value is shown in Equation (9).

$$\beta \in [0,1] \tag{9}$$

In Equation (9), the closer the value is to 1, the more work tasks are scheduled and the more uneven the demand distribution is. Therefore, it is necessary to comprehensively consider the actual situation of the enterprise when setting the value. The mathematical model of human resources workload balance LD_r is shown in Equation (10).

$$LD_r = \frac{\sum_{r=1}^{r=m} \left(\sum_1^n \sum_{t=ES_i}^{t=LS_i} y_{i,r}^t \times l_i - \frac{U_r}{m}\right)^2}{m} \tag{10}$$

In Equation (10), U_r reflects the total working hours of the entire property project, $\frac{U_r}{m}$ represents the average workload of the property. It represents the time $y_{i,r}^t$ when the activity i starts, and human resources r are involved. It is 1 if it is, and 0 if it is not, l_i represents i, the duration of the activity and m is the task amount. The total time U_r schedule of the property project is shown in Equation (11).

$$U_r = \sum_{i=0}^{i=n} \sum_{k=1}^{k=q} b_i^k \times l_i \tag{11}$$

In Equation (11), k represents skills, and the total number of skills is q, represents b_i^k, the number of human resources that need to master skills for activity i. k At the same time, the mathematical model of human resource demand distribution LD_t, as is shown in Equation (12).

$$LD_t = \frac{\sum_{t=1}^{t=T} \left(Q_t - \frac{\sum_{i=1}^{i=n} \sum_{k=1}^{k=q} b_i^k \times l_i}{T}\right)^2}{T} \tag{12}$$

In Equation (11), T represents the time period, and its expression is as shown in Equation (13).

$$T = \{0,1,2,\ldots,T_{max}\} \tag{13}$$

In Equation (13), $T_{\max}$ represents the upper bound of the optimal solution, and the minimum construction period T_i value obtained is less than $T_{\max}$. The human resource demand at t time is shown in Equation (14).

TABLE I
MODEL INITIAL PARAMETERS

Parameter indicator type	Numerical value
GA scale	30
PSO learning factor	2
GA population size	160
Iterations	500
GA crossover rate	0.6
GA mutation rate	0.1

$$Q_t=\sum_{i=1}^{i=m}\left[\sum_{t=amx\{ES_i,t-l_i+1\}}^{t=\min\{t,LS_i\}}\left(x_i^t\sum_{k=1}^{k=q}b_i^k\right)\right] \quad (14)$$

The entire task scheduling needs to meet relevant constraints, including that the task time should be within the earliest and latest time; priority tasks should also be considered, and the next task can only be carried out after the previous task is completed; it means that the project intelligence is carried out at the specified time, and a certain moment is carried out $y_{i,r}^t$ as 1, 0 if not [20]. Then the property manpower dispatching target constraint is shown in Equation (15) [21].

$$\begin{cases}\sum_{t=ES_i}^{t=LS_i}x_i^t=1 \quad \forall_i \\ \sum_{t=ES_i}^{t=LS_i}x_i^t\cdot t+l_i\leq_i\sum_{t=ES_i}^{t=LS_i}x_i^t\cdot t \quad \forall(i,j)\in p_2 \\ \sum_{t=ES_i}^{t=LS_i}y_{i,r}^t\leq 1 \quad \forall_{i,r} \\ y_{i,r}^t\leq x_i^t \quad \forall_{i,r,t}\end{cases} \quad (15)$$

In Equation (15), p_2 represents the priority relationship. If the activity i has no critical relationship, then the subsequent task is defined as i, the follow-up task j. The final optimization goal is $Minimze\ F(f_1,f_2)$ to solve f_1 and f_2 minimize the value. There are many common multi-objective optimization methods, including particle swarm algorithm, ant colony algorithm, heuristic algorithm, etc. In multi-objective task scheduling optimization, the time set is $T=\{0,1,2,\ldots,T_{max}\}$, T_{max} is the upper bound of the minimum task duration, and $T_{\min}\geq T_{\min}$ the most effective solution method is to take the sum of all task durations as $T_{\max}$, but this solution will increase model constraints. Therefore, the heuristic algorithm set branch node method is used to solve the Pareto front [22]. This method limits the earliest start time of each job based on the time task priority relationship, and then uses a heuristic algorithm based on the minimum earliest time priority rule to solve the problem, obtaining the minimum upper bound and reducing the search space of the score definition algorithm $T_{\max}$ [23]. The entire property human resources scheduling process is shown in Fig. 5.

In Fig. 5, the optimization goal is to minimize the task duration goal and resource scheduling goal. Within a limited time, through the task constraint priority relationship, tasks will be assigned as early as possible, and the task scheduling and human resource scheduling status will be updated in real time. The next task assignment will continue until all tasks are assigned. Through the above operations, the optimization of scheduling and management of property human resources can be achieved.

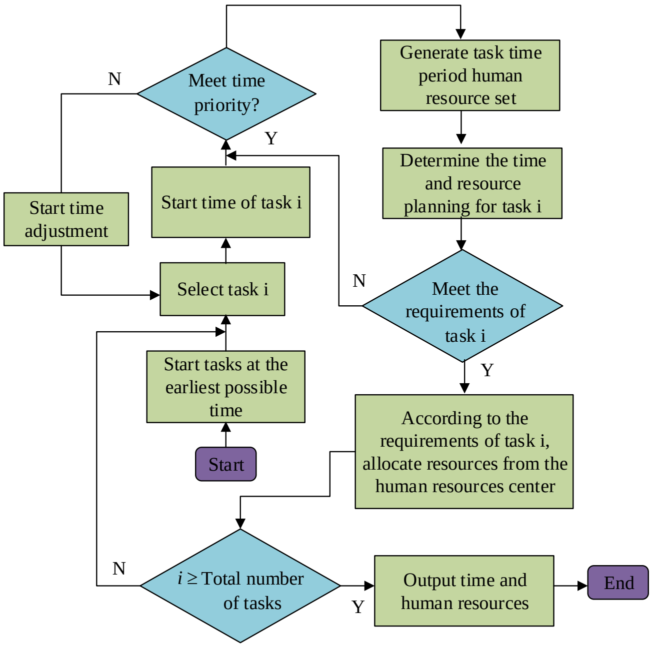


Fig. 5. Schematic diagram of human resource scheduling process for property management.

IV. EXPERIMENTAL ANALYSIS OF HUMAN RESOURCES MANAGEMENT MODEL BASED ON SPRING CLOUD FRAMEWORK

This part mainly verifies the application effects of the two models in actual scenarios, including human resource recommendation experiments and scheduling experiments. Inspection indicators include precision rate, recall rate, recommendation accuracy, etc.

A. *Experimental Analysis of Human Resources Recommendation Model*

In order to analyze the application effect of the proposed human resources management model, experimental testing will be conducted on the WINDOWS 10 64-bit platform, and Scala and Mat lab will be used to complete the experimental simulation analysis. The recruitment data of a large property company's human resources platform was selected for the experiment. There are 10,356 pieces of data in total. The data set contains 12,562 applicants, 23,564 pieces of user behavior data, and 835 positions. Before the experiment, the relevant parameter settings of the experimental model are shown in Table I.

The Probabilistic Matrix Factorization (PMF) and Singular Value Decomposition (SVD) models are introduced as test benchmarks. Root Mean Squared Error (RMSE), Mean

Absolute Error (MAE), Precision (Precision) and Recall (Recall) are used to evaluate the application effect of the recommended model. The error test results are as shown in the following Fig. 6.

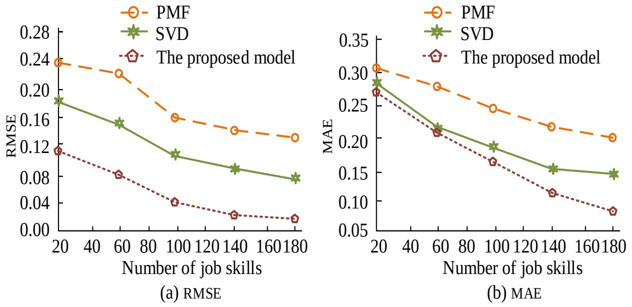


Fig. 6. Human resources recommendation error results.

According to the results in Fig. 6, there are large differences in the recommendation results of different models. As the number of job skills increases, the errors of the three recommendation models continue to decrease. For example, in the root mean square error analysis, the three recommended models all achieved the minimum error when the number of job skills was 180, and the ones of PMF, SVD and the designed model were 0.166, 0.085 and 0.013. At the same time, comparing the average absolute errors of different models, the proposed model has the lowest error performance under different work skills. When the number of work skills is 180, the minimum average absolute error is obtained, which is 0.073, while PMF and SVD are 0.235 respectively. with 0.166. Compare the recommendation performance of different models in actual scenarios, as shown in Fig. 7.

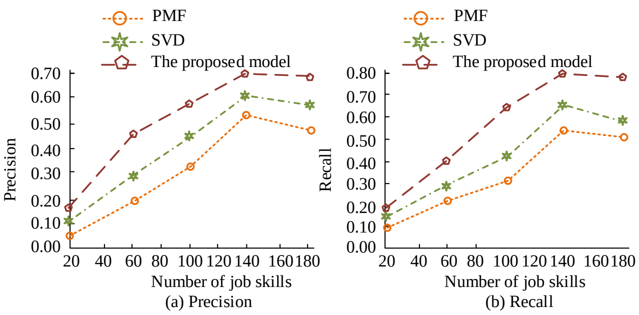


Fig. 7. Recommendation accuracy and recall of different models.

Fig. 7(a) shows the recommendation accuracy results of the model, comparing between different models. All three models achieved maximum values when the number of jobs was 140, and the recommendation accuracy rates of PMF, SVD and the designed model were 0.533, 0.604 and 0.703. Fig. 7(b) shows the model recommendation recall results. The designed model performed best, which achieves the best results when the number of job skills is 140, with a recall rate of 0.802, followed by the SVD model, with the best recall rate of 0.633, the worst performer is PMF, with the best recall rate of 0.541. Select management positions and service positions to compare the recommendation effects of different models. The results are shown in Fig. 8.

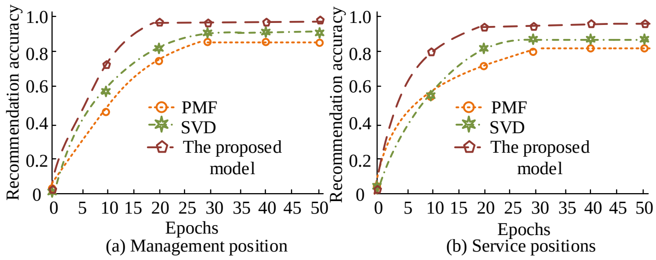


Fig. 8. Comparison of recommendation accuracy for different models.

As shown in Fig. 8, management and service positions are selected as objects to compare the differences between the two models. Fig. 8(a) shows the recommendation accuracy results for management positions. The proposed model achieved convergence the fastest among the three, with the best recommendation accuracy of 0.982, followed by the SVD model, with the best recommendation accuracy of 0.902. The performance The worst is PMF, with the best recommendation accuracy of 0.823. Fig. 8(b) shows the recommendation results of service positions. The best performance is still the proposed model. The recommendation accuracy of PMF, SVD and the designed model are 0.778, 0.836 and 0.976. It can be seen that the proposed model has the best recommendation performance in actual human resources recommendation. Finally, compare the comprehensive performance effects of different recommendation techniques, as shown in Table II.

Table II shows the comprehensive comparison results of different models. In terms of average recommendation time, recommendation stability, and average recommendation accuracy, the study model performed the best. Especially in stability comparison, the stability of the research model is 99.65% and 99.75% respectively for small-scale and large-scale quantities, both of which are superior to other models. It can be seen that the technology proposed by the research institute has better application effects.

B. Experimental Analysis of Human Resources Scheduling Model

In the human resources scheduling experimental analysis, select a property project to carry out experimental analysis. The main tasks of this property include equipment maintenance management, green plant maintenance, cleaning services, parking space management, community security services, etc. One of the projects was selected as the experimental object. This project is mainly responsible for carrying out equipment maintenance for community users. The specific work tasks are shown in Table II.

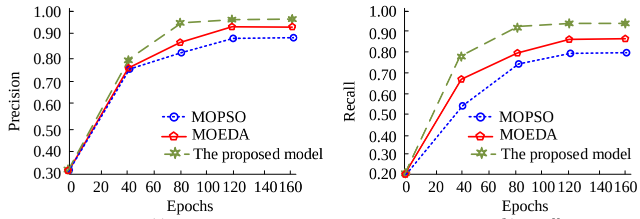
Table III is a detailed list of tasks and task time for a property project, which stipulates that project tasks need to be solved within 3 days. In the experimental analysis, the Multi-Objective Particle Swarm Optimization (MOPSO) and Multi-Objective Evolutionary Algorithms (Multi-Objective) were introduced. Evolutionary Algorithm Based on Decomposition, MOEAD) for benchmark comparison. The performance comparison of different scheduling models is shown in Fig. 9.

TABLE II
COMPARISON OF COMPREHENSIVE PERFORMANCE OF DIFFERENT MODELS

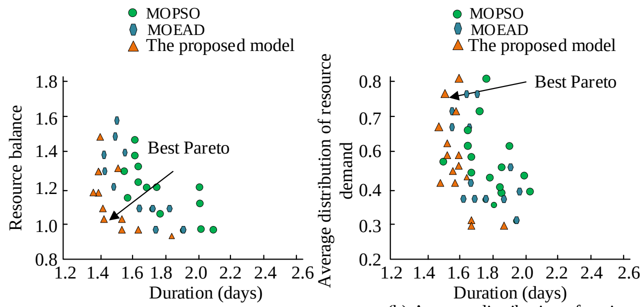
Number of job skills	Indicator items	PMF	SVD	Research model
Small-scale	Recommended average time (s)	0.865	0.726	0.422
	Recommended average accuracy	0.854	0.894	0.943
	Recommended stability (%)	91.56	94.65	99.65
Large-scale;	Recommended average time (s)	0.965	0.856	0.489
	Recommended average accuracy	0.865	0.915	0.968
	Recommended stability (%)	92.65	94.98	99.75

TABLE III
TASK CONTENT AND TIME OF PROPERTY A PROJECT

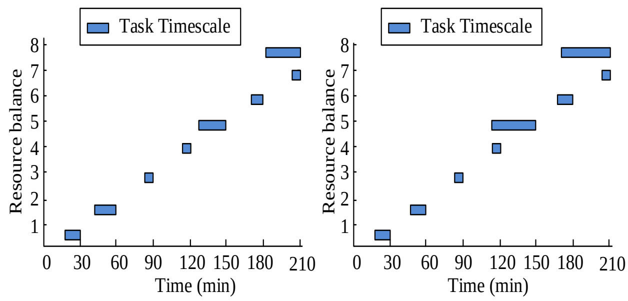
Task Number	Task content	Task time
1	Customer feedback analysis	3 min
2	Related user data extraction	30 min
3	Telephone consultation content	10 min
4	Confirm and register specific issues	5 min
5	Arrange maintenance personnel to provide services	60 min
6	Telephone consultation with clients to arrange a visit time	15 min
7	Select service personnel	15 min
8	Dispatch on-site maintenance services	60 min



(a) Precision (b) Recall
Fig. 9 Training results of different scheduling models



(a) Duration and resource balance (b) Average distribution of project duration and resource requirements
Fig. 10. Pareto optimal frontier results of the model.



(a) Option 1 (b) Option 2
Fig. 11. Two human resource scheduling solutions.

Fig. 9 (a) shows the accuracy results of different models, among which the best performing is the model proposed by the research institute, which can converge in the shortest time with an iteration of 80 and has the highest accuracy value compared to other models, which is 0.975. Fig. 9 (b) denotes the recall test outcomes of different scheduling models. The MOPSO model and MOEDA model both converge after 120 iterations, with recall rates of 0.802 and 0.895, respectively. The best performing model is the one proposed, which converges after 80 iterations with a recall value of 0.946. It can be seen that the scheduling model proposed by the research institute performs better overall. Next, we will test the frontier results. Fig. 10 shows the Pareto optimal frontier results for three scheduling models.

Fig. 11 shows the scheduling diagram of the two options. The original project plan took 198 minutes, and the construction period required the customer's problem to be solved within 3 days. Option 1 is shorter, but consumes more resources. The optimized project takes 121 minutes and the construction period is shortened to 1.6 days, but the human resource scheduling cost increases by 6.3% compared to the planned target. Option 2 has lower human resources than Option 1, but the project takes 162 minutes longer, the construction period is shortened to 2.5 days, and the overall resource scheduling cost is 9.2% lower than the planned target. Finally, compare the relationship between human resources and construction period in Scheme 1, as shown in Fig. 12.

According to the results in Fig. 12, as the number of human resources increases, the construction period gradually decreases, but when the number of human resources reaches 6 people, both the construction period and the resource balance are stable. In the comparison between the construction period and the number of skills, as the number of skills per capita increases, the construction period gradually decreases, but the construction period remains saturated when the number of skills per capita is 4. Therefore, option 1 can shorten the construction period to 1.6 days, with 4 to 6 human resources and 4 skills per person. The company selects the final plan based on its needs. The construction period of Plan 1 is significantly shortened, but the labor cost increases. Option 2 shortens the construction period and reduces labor costs. With only 3 people and 2 per capita skills, the goal can be completed in 2.5 days. Finally, a comprehensive comparison is conducted as shown in Table IV.

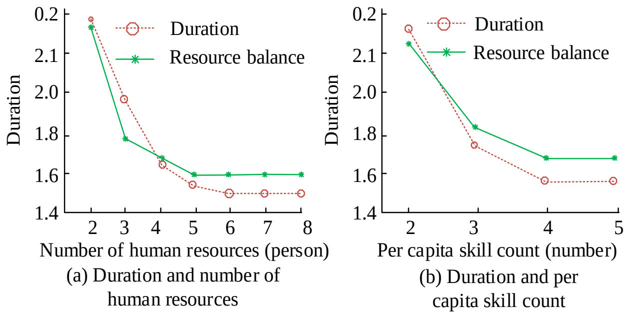


Fig. 12. Comparison of the relationship between human resources and construction period.

TABLE IV
COMPREHENSIVE TEST RESULTS OF MULTIPLE METHODS

Method	MOPSO	MOE-AD	Research method	Task original plan
Task Duration (d)	2.9	2.8	2.5	3
Task Time (h)	182	190	162	198
Cost	96.25%	90.25%	75.58%	100%
Number of manpower (number of people)	6	4	3	8

Table IV shows the comprehensive test results of multiple methods. From the results, it can be seen that the research method has advantages over the other two methods in terms of task time, project time, cost, and manpower. In terms of cost, the research method cost is only 75.58% of the original cost, while MOPSO and MOEAD are 96.25% and 90.25% respectively, which is better than other methods. It can be seen that research methods perform better in practical applications.

V. CONCLUSION

Traditional property human resources management faces problems such as mismatch of human services and unreasonable scheduling. In this regard, an intelligent human resources management platform is designed based on the Spring Cloud framework. In order to solve the problem of human service mismatch, a human resources recommendation model based on an improved genetic algorithm is proposed. By analyzing human resources data, collaborative filtering and genetic algorithm are used for ranking and classification, so as to achieve content recommendation. Aiming at the human resource scheduling problem, a multi-objective task scheduling model is constructed considering the task time priority relationship, and the branch-bound method and heuristic method are used to solve the multi-objective problem. In the experimental analysis of human resources recommendation, the recommendation accuracy rates of PMF, SVD and the designed model were 0.53 3, 0.60 4 and 0.70 3 respectively. In the recall analysis, the designed model performed best at 0.54 1. At the same time, the recommendation accuracy between different models was compared. In the service position recommendation, the recommendation accuracy of PMF, SVD and the proposed model were 0.778, 0.836 and 0.976 respectively. In the experimental analysis of human resource scheduling, the proposed model improved the optimization performance by 15.6% and 9.8% compared with MOPSO and MOEAD. The proposed model was used to optimize project A, and two options were finally obtained. In option 1, the construction period was shortened to 1.6 days, and the human resource scheduling cost increased by 6.3%. The construction period of Plan 2 is shortened to 2.5 days, and the human resource scheduling cost is reduced by 9.2%. Both options can meet the development requirements of real estate human resources, and specific options can be selected based on the situation. The proposed model has high accuracy in human resource recommendation and service position recommendation, and has achieved better performance improvement in human resource scheduling than MOPSO and MOEAD. However, there are still some limitations to the research, as it has not fully considered the needs of employees and the need for diversified data sources, which require further improvement. Future research needs to further consider the personalized needs of leaders and employees, while optimizing models and improving the effectiveness of research technology applications.

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