Hindawi
Complexity
Volume 2021, Article ID 6676908, 12 pages
https://doi.org/10.1155/2021/6676908

Research Article

Qualitative Simulation Algorithm for Resource Scheduling in Enterprise Management Cloud Mode

Jiaohui Yu

Business School, Shandong Jianzhu University, Jinan 250101, China

Correspondence should be addressed to Jiaohui Yu; yujiaohui19@sdjzu.edu.cn

Received 14 December 2020; Revised 7 February 2021; Accepted 10 February 2021; Published 23 February 2021

Academic Editor: Wei Wang

Aiming at the problem of resource scheduling optimization in enterprise management cloud mode, a customizable fuzzy clustering cloud resource scheduling algorithm based on trust sensitivity is proposed. Firstly, on the one hand, a fuzzy clustering method is used to divide cloud resource scheduling into two aspects: cloud user resource scheduling and cloud task resource scheduling. On the other hand, a trust-sensitive mechanism is introduced into cloud task scheduling to prevent malicious node attacks or dishonest recommendation from node providers. At the same time, in the cloud task scheduling, cloud resources are divided according to the comprehensive performance of resources, and the trust sensitivity coefficient of each type of task resources is calculated. Then, according to the trust sensitivity coefficient, the matching cloud tasks are selected for users. Through the comparison of simulation experiments, the customized fuzzy clustering cloud resource scheduling algorithm proposed in this paper reduces the user's cost of selecting cloud service provider in the cloud resource scheduling. It not only embodies the principle of cloud resource allocation on demand but also can give full play to the advantages of cloud resources and improve the throughput of the whole cloud system and the satisfaction of cloud users.

1. Introduction

The traditional enterprise management lays particular stress on the management of the production process and considers that the source of economic benefits of enterprises can only be the production of products, so it is natural that the priority of quantity and output value is justified. Therefore, the management of management attaches importance to the production process [1, 2]. Modern enterprise management believes that the economic benefit of an enterprise depends on many factors in the enterprise, such as whether the business decision is correct, whether the product design innovation is reasonable and timely, and whether the staff's enthusiasm is exerted [3–5]. In a word, to a large extent, it depends on all kinds of resource scheduling. Traditional resource scheduling algorithms generally separate the attributes of resources from their service classes when describing the characteristics of resources. Therefore, the description of comprehensive service capabilities of resources has certain limitations. The traditional scheduling method mainly takes the whole service resource as the selection object, without considering the characteristics of the resource itself and user preference, which will not only increase the cost of service resource selection but also affect the performance of the system [6]. The traditional scheduling algorithm will let all users compete together instead of allocating resources by a single user. Although it seems to be in line with the allocation principle, it has no commercial operation value and ignores the trust sensitive problem in resource scheduling.

For the resource scheduling optimization problem in cloud service environment, many scholars have invested a lot of manpower and material resources to do related research. At present, the scheduling research of cloud resources mainly refers to the scheduling optimization method in grid computing. Due to the great difference between the two, cloud computing system is mainly used in the huge data processing field, while the grid computing system tends to the scientific computing field, so it cannot be completely studied according to the scheduling method of grid computing system [7, 8]. At present, in the distributed environment, the traditional scheduling algorithms to complete the task in the shortest time include max min, Min Min Min, OLB, and greedy algorithm, while the scheduling optimization algorithms based on stochastic algorithm and artificial intelligence include genetic algorithm, particle swarm optimization algorithm, and ant colony algorithm, which have adaptive search ability [9].

In order to improve the resource utilization of cloud users and reduce the huge cost of cloud task scheduling, a more reasonable resource scheduling method is proposed [10]. A customizable fuzzy clustering cloud resource scheduling algorithm with trust sensitivity is proposed. Firstly, on the one hand, a fuzzy clustering method is used to divide cloud resource scheduling into two aspects: cloud user resource scheduling and cloud task resource scheduling. In cloud user resource scheduling, cloud users and cloud providers are automatically bound to reduce the cost of resource scheduling. On the other hand, a trust-sensitive mechanism is introduced into cloud task scheduling to effectively prevent malicious node attacks or dishonest recommendation from node providers. At the same time, in the cloud task scheduling, cloud resources are divided according to the comprehensive performance of resources, and the preference coefficient of each type of task resources is calculated. Then, users can select more matching cloud resources according to the trust sensitivity coefficient of resources. Through the comparison of simulation experiments, this paper proposes a customized fuzzy clustering cloud resource scheduling algorithm based on trust sensitivity, which can reduce the cost of selecting cloud service providers. It not only embodies the principle of cloud resource allocation on demand but also can give full play to the advantages of cloud resources and improve the throughput of the whole cloud system and the satisfaction of cloud users.

2. Enterprise Comprehensive Operation and Maintenance Management Platform Based on Cloud Computing

2.1. Task-Oriented Integrated Operation and Maintenance Management Architecture. Task-oriented cloud computing service and data resource management system is a unified network management framework technology in the cloud computing environment. It includes describing the application of network service requirements in a unified language, optimizing it in combination with user needs, and seeking to achieve effective resource allocation based on global strategy, which is related to the optimization of mapping strategy and resource recovery [11, 12]. The overall architecture of the task-oriented cloud computing service and data resource management system is shown in Figure 1. The architecture includes the following four types of information interaction subjects:

(1) Users

Users are the users of task-oriented cloud computing services and data resource management system. They are responsible for proposing requirements, formulating strategies, and comprehensive cloud network operation management and maintenance. Users mainly use the integrated operation and maintenance controller to realize information interaction, which includes task requirement information, virtual machine network planning information, static and dynamic policy information, etc. Among them, the service selection algorithm in Section 2 is used to select operation and maintenance services.

(2) Integrated operation and maintenance controller

The integrated operation and maintenance controller accepts the user's requirements and is responsible for the implementation of policy deployment. The information interaction parties are users, underlying cloud physical resources and network controller. The main interactive information includes receiving the user virtual machine demand strategy, translating the user network requirement strategy into logical requirement, delivering it to the network controller, receiving the deployment strategy from the network controller, and configuring the deployment strategy in the underlying cloud physical resources.

(3) Network controller

The network controller provides resource status monitoring and the formulation of specific policy configuration parameters. The underlying cloud physical resources and integrated operation and maintenance controller are its information interaction parties. The main information to be interacted includes the logical requirement information transmitted by the integrated operation and maintenance controller. After receiving the information, the network controller obtains the current status of network equipment through the underlying cloud network and finally transmits the network resource status and optimized virtual machine placement and network configuration strategy to the integrated operation and maintenance controller.

(4) Underlying cloud physical resources

Through the above discussion and analysis of other interaction subjects, it can be concluded that the information interaction parties of the underlying cloud physical resources are network controller and integrated operation and maintenance controller. The information responsible for interaction specifically includes the following: the integrated operation and maintenance controller will transfer the actual network configuration and virtual machine configuration to the cluster controller. Through the cluster controller, the network controller can detect its device status.

Based on the functional level, in order to ensure that the user's needs in network resource self-defined configuration can be met, network controller and integrated operation and maintenance controller are the two most important parts of the system [13]. Among them, the management of the

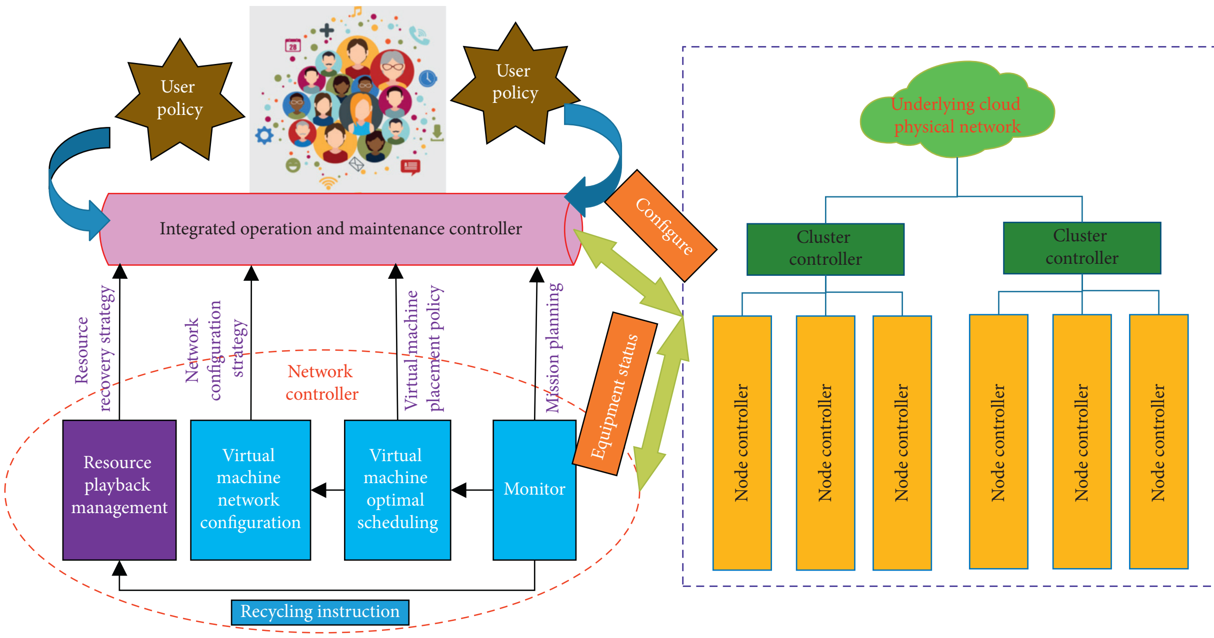

FIGURE 1: Task-oriented integrated operation and maintenance management system.

physical host and virtual resources is in the charge of the integrated operation and maintenance controller, and the user API interface is also provided by the integrated operation and maintenance controller. Through the API interface, users can set their own network policy requirements. The network controller is responsible to the management and monitoring of network equipment configuration. At the same time, the integrated operation and maintenance controller can also obtain services related to network and virtual machine configuration, so as to determine how to configure virtual machine in the underlying physical network.

In the integrated operation and maintenance management system, the integrated operation and maintenance controller is a very important controller component, which is responsible for the planning, resource deployment, and management of the underlying cloud resources [14]. Therefore, the component is very important. As the front section of each cluster, each cluster controller is controlled by the integrated operation and maintenance controller. By using the corresponding physical equipment, each cluster controller can be connected with the node controller in the cluster, so as to realize the efficient maintenance of all information of the node controller. Moreover, the life cycle of these instances is also responsible by the component, and services such as security group and firewall are provided according to the network mode. However, the node controller focuses on the management of host operating system, virtual machine monitor, and virtual network endpoint.

Figure 2 shows the basic operation process of task-oriented cloud computing service and data resource management system. It can be described in detail as follows. The user describes the network service to be configured through a simple policy language. When the integrated operation and maintenance controller receives the user virtual network deployment strategy, the integrated operation and maintenance controller can translate the user's policy requirements and obtain the logical requirements.

Then, the integrated operation and maintenance controller will transmit the user's logical requirements to the network controller and consult the latter for the optimal configuration strategy. After receiving the current state of the cloud controller, it analyzes whether the current network controller can meet the needs of the current network. If it can meet the requirements, it can be deployed. At this time, the network controller will get the optimization mapping strategy through the virtual network mapping optimization algorithm and transmit it to the integrated operation and maintenance controller. Then, the integrated operation and maintenance controller is responsible for the actual deployment of the underlying cloud network. On the contrary, if the remaining physical resources are not enough to meet the user's deployment requirements, the user's request will be rejected and the maximum number of redeployments will be judged. If the upper limit is not reached, you can continue to wait for the next deployment. Otherwise, if the upper limit is reached, the deployment requirement will be abandoned and the message should be delivered to the user.

In short, the network controller will use the optimization algorithm to obtain the virtual machine deployment rules according to the logic requirements received by the network controller and the remaining status of the underlying network resources. Finally, the virtual machine resources will be allocated and deployed in the underlying cloud network based on the rule.

2.2. Adaptive Cloud Computing Network Scheduling Design.

Task-oriented integrated operation and maintenance management system can describe the network services that users

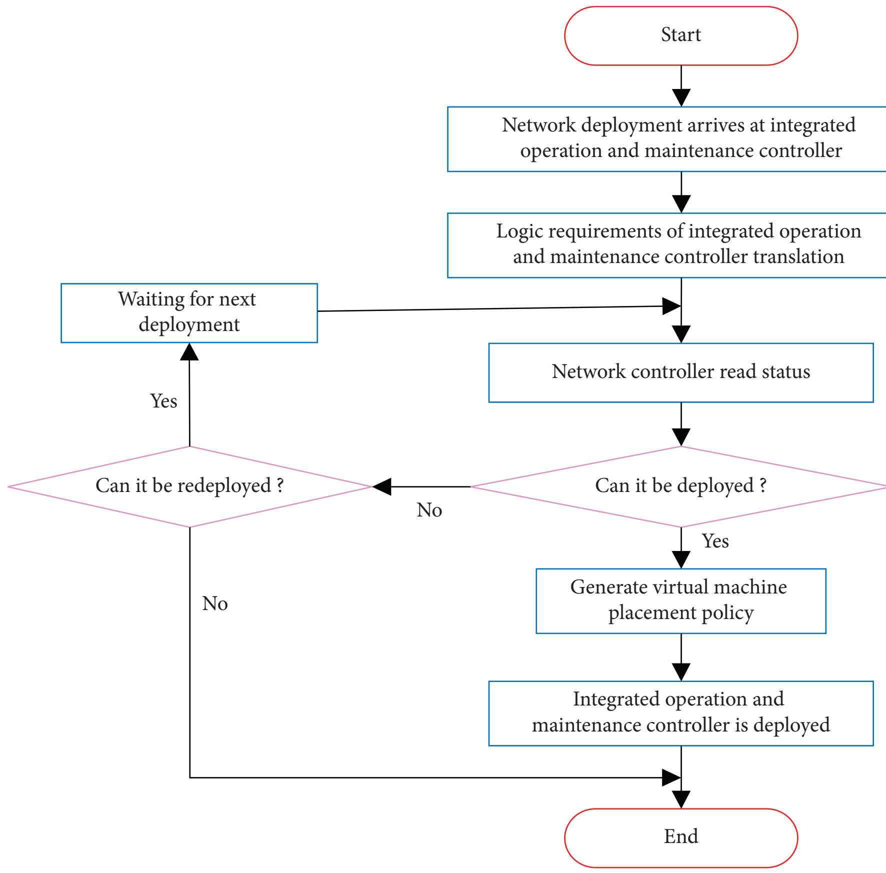

FIGURE 2: Process of task-oriented integrated operation and maintenance management system.

need through simple policy language. After receiving the user virtual network deployment strategy, the integrated operation and maintenance controller translates it into user logic requirements. According to the user's logical network resource requirements, a resource view oriented to multi-objective task requirements is established. Based on the task resource view, the virtual machine network planning is carried out by using the analytic hierarchy process (AHP). Finally, the network planning results are described and sent to the cluster controller and node controller for virtual machine deployment. After the virtual machine deployment is completed, in the running process, based on the load characteristic value, the comprehensive load optimization scheduling of the virtual machine is carried out.

Physical machine and virtual machine resources include CPU, memory, external memory, network bandwidth, network connection, routing, and switching link of physical machine and virtual machine, with different resource attributes. It is necessary to describe the network resources uniformly at the task level, that is, to provide a task-oriented resource view. The resources in this view are in the form of abstract resource description, including the attributes of managed object resources, related operations, functions, and results. Task-oriented resource description can achieve the following goals:

(1) Technical details of shielding different resource data structures

The configuration and operation information of physical machine and virtual machine adopt different data structures, and the task-oriented resource view is used to provide management task with management view which can shield semantic details of different resources. Although adding trust-sensitive mechanism in multiuser scheduling ensures the fairness of resource scheduling. However, due to the complexity and diversity of cloud service resources, it is impossible to accurately define the identity of cloud users, which may bring malicious service attacks when accessing cloud resources.

(2) Communicate different types and management levels of network resources

There are different types and different levels of virtual machine subnets in virtual network environment. Task-oriented resource view shields the technical details of resource data structure, which is convenient for communication with various types and levels of network resources. For the same resource description, the resource information types corresponding to different attributes may be different. Therefore, different management protocols may be needed to realize the final access to these attributes. The operation and maintenance personnel can represent the resources related to this management task in the same resource view and then manage them with the member method of this view.

(3) Multiobjective requirements for management tasks

Based on the management task-oriented description of resources, the complexity of management is reduced. In a specific resource view, only the network resources that are closely related to this task, as well as the events and operations on the resources of this part are included, rather than all the network resources. Management and maintenance personnel do not need to care about the network resources unrelated to the management task when they plan the virtual machine network on the resource view. The task-oriented view of network resources is shown in Figure 3.

The management task layer includes various specific functional business activities planned and decomposed according to the task. Each management task may need multiple uniform resource description object services. In essence, the unified resource view layer is a management semantic layer, which makes the management tasks do not need to consider the technical details of virtual network resources through unified resource view object (URVO) and abstract resource description language (ARDL). URVO layer is a resource view oriented to management tasks, which greatly improves the development efficiency of management applications.

3. Cloud Service Trust Evaluation Model Based on Extension Cloud

3.1. Construction of Task Scheduling Model in Cloud Environment. Cloud model is developed from fuzzy set theory and probability theory. It can reflect the transformation of quantitative value and qualitative concept. It is also a new theory that unifies the laws of randomness and fuzziness in human knowledge and things. Because cloud model inherits the characteristics of normal distribution and normal membership function, cloud model has unique mathematical properties. So far, many kinds of distribution forms of cloud model are widely used in all walks of life. In this paper, we use the normal distribution characteristics of cloud model to reconstruct the matter-element theory in extenics. In the entire resource scheduling, a cloud provider with a high degree of trust is selected according to the actual requirements of users, and cloud users are mainly used as the core of overall resource scheduling. In task scheduling, the user selects satisfactory service resources in the cloud resource pool according to the trust sensitivity coefficient of the user's access to the system task.

The normal cloud model is represented by the expected value Ex, entropy En, and superentropy He. Among them, the expected value Ex represents the central position of the universe and is the point that best reflects the qualitative concept of entity attributes; that is, the membership degree of cloud is represented on the distribution map. Entropy En is a mathematical expression of the uncertainty of the concept of entity attributes, which can best reflect the randomness and fuzziness of qualitative concepts. In other words, the span of clouds is represented on the cloud distribution map. The greater the entropy value, the greater the span of clouds. Superentropy He is a measure of the uncertainty of entropy En and relates the randomness and fuzziness of qualitative concepts. It represents the randomness of sample data collection and represents the dispersion degree of cloud droplets on cloud distribution map. The larger the value of superentropy, the thicker the cloud image. In this paper, we use the digital characteristics of normal cloud model to reconstruct the cloud membership function, which can solve the problem of uncertainty of cloud service trust evaluation level limit value, so as to achieve the effect of softening the hierarchical region.

The matter-element theory in extenics is mainly based on matter element, which describes the name n, characteristic w, and quantity value of things, which is recorded as TD (w, t, b). In the traditional matter-element evaluation model, t is used to represent the critical value of each evaluation index. Generally, it is defined as a constant value or an interval value, and its own uncertainty is often not considered. If a thing has multiple attribute characteristics, the matter-element idea in extenics is as follows:

$$\mathrm{TD} = \begin{bmatrix} w_1 & t_1 & b \\ w_2 & t_2 & b \\ & \cdots & \\ w_n & t_n & b \end{bmatrix}. \tag{1}$$

In this paper, we use the randomness and fuzziness of normal cloud model to reconstruct and improve the matter-element model in extenics. The normal cloud model is usually marked as $\Delta E(\mu)$. The normal cloud model is introduced into the matter-element idea of extenics to reconstruct it:

$$\mathrm{TD} = \begin{bmatrix} w_1 & t_1 & b & \Delta E(\mu_1) \\ w_2 & t_2 & b & \Delta E(\mu_1) \\ & & \cdots & \\ w_n & t_n & b & \Delta E(\mu_1) \end{bmatrix}. \tag{2}$$

Since cloud computing is a commercial service developed on the Internet platform, there is still a trust relationship between the services of its Internet entities. The trust between service entities in this article refers to trust sensitivity. Based on the previous trust evaluation model, this paper presents a service trust evaluation model based on cloud model and introduces extension theory to propose a cloud service trust evaluation method based on extension cloud theory. Depending on the advantages of trust model evaluation, the value x corresponding to each cloud service index involved in the evaluation is regarded as a single cloud drop on the extension cloud map, and the random expectation value Ex and the normal distribution variance ne with He as the standard deviation are generated by the corresponding cloud generator. Finally, the cloud correlation degree K between the evaluation value x corresponding to

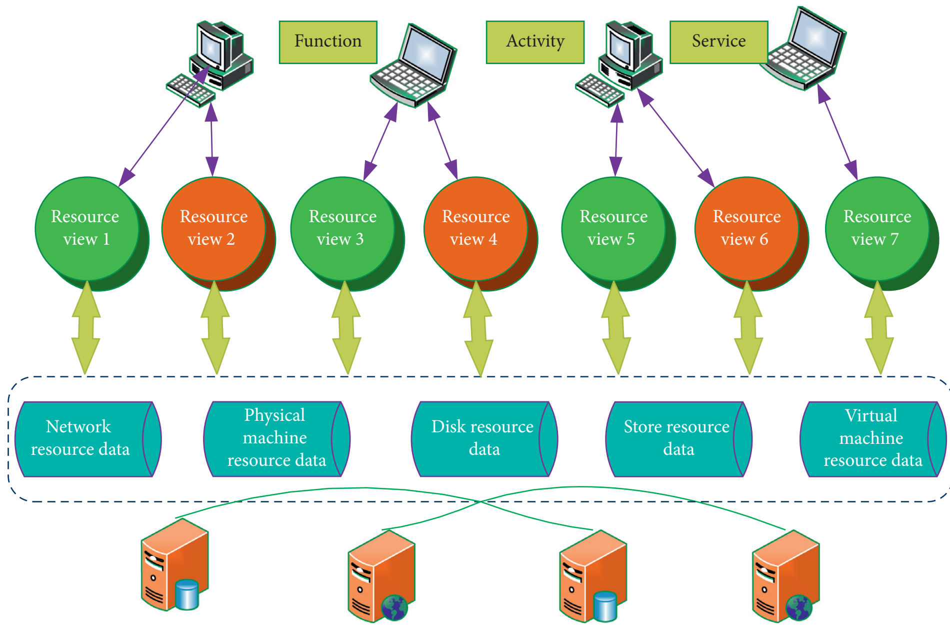

Figure 3: Task-oriented view of network resources.

each cloud service index and the normal extension cloud model of cloud service trust level boundary is calculated. The mathematical expression is as follows:

$$\varphi(t) = \frac{1}{2}\sum_{k=0}^{N}\left[(X-\mathrm{Ex})^2 + \xi s(\mathrm{loss})^n\right]. \quad (3)$$

Let Ex be the domain set of cloud service research, X be the special attribute of trust or and trusted entity, and t be the hierarchical language value of cloud service-trusted entity attribute. The trust membership degree $\varphi(t)$ described by T is called extension trust cloud. Each attribute tuple on the universe set and the order pair of its extension cloud membership degree are called extension trust cloud drops.

In complex cloud computing, the attribute entity's trust degree is obtained by using the extension cloud theory to evaluate the attribute entity of each cloud service entity and reflects the randomness, fuzziness, and uncertainty of obtaining the attribute trust degree of evaluation entity. The evaluation model is shown in Figure 4.

According to the uncertainty of matter-element theory and cloud model, the advantages of matter-element theory and qualitative and quantitative analysis are combined to determine the trust level of each cloud service entity. The trust level is divided into several trust intervals, and the extension trust cloud is generated by standard extension trust cloud generator. According to the requirements of cloud service entity attribute trust evaluation, the sample data collected are preprocessed. Secondly, the extension reverse trust cloud is generated by the reverse weighted cloud generator from the trust information describing the cloud service entity, and the existing cloud service entity attribute trust cloud is updated in real time to obtain a new extension trust cloud. Finally, according to the similarity of extension trust cloud, the current trust value is calculated and the current trust level is obtained. The comprehensive trust value of the attribute is calculated by comparing the current trust value with the historical trust value, and the appropriate cloud provider is selected according to the comprehensive trust value.

3.2. Simulation Algorithm of Cloud Resource Scheduling Based on Fuzzy Clustering. This paper proposes a trust sensitive customizable fuzzy clustering cloud resource scheduling algorithm (tscfcars): according to the user's demand for accessing resources and the allocation and utilization between cloud service providers and resources, it binds multiple cloud users to their cloud service providers and cloud service resource sets. In the actual cloud resource scheduling, due to human factors in the scheduling of multiple cloud users, the efficiency and number of execution of resource scheduling are greatly reduced. The task scheduling is to bind the single user task resource with its submitted service list. Therefore, a sensitive mechanism is added to the multiuser scheduling to ensure the efficiency and security of resource scheduling. This paper will study the multitask fuzzy clustering cloud resource scheduling method and the single task fuzzy clustering cloud resource scheduling method. The specific scheduling process is shown in Figure 5.

The resource scheduling model is implemented in the open cloud environment. The cloud service information center (CISC) and cloud User Service Center (USC) are set up in the system. Firstly, the cloud provider registers with the cloud service information center; secondly, when the cloud user logs in for the first time, it needs to register with USC and generate the cloud user account, and submit the cloud user's demand information to CSC according to the cloud user's account. Finally, according to the user service center's request information, help it to obtain the relevant cloud provider information, calculate the trust degree of the

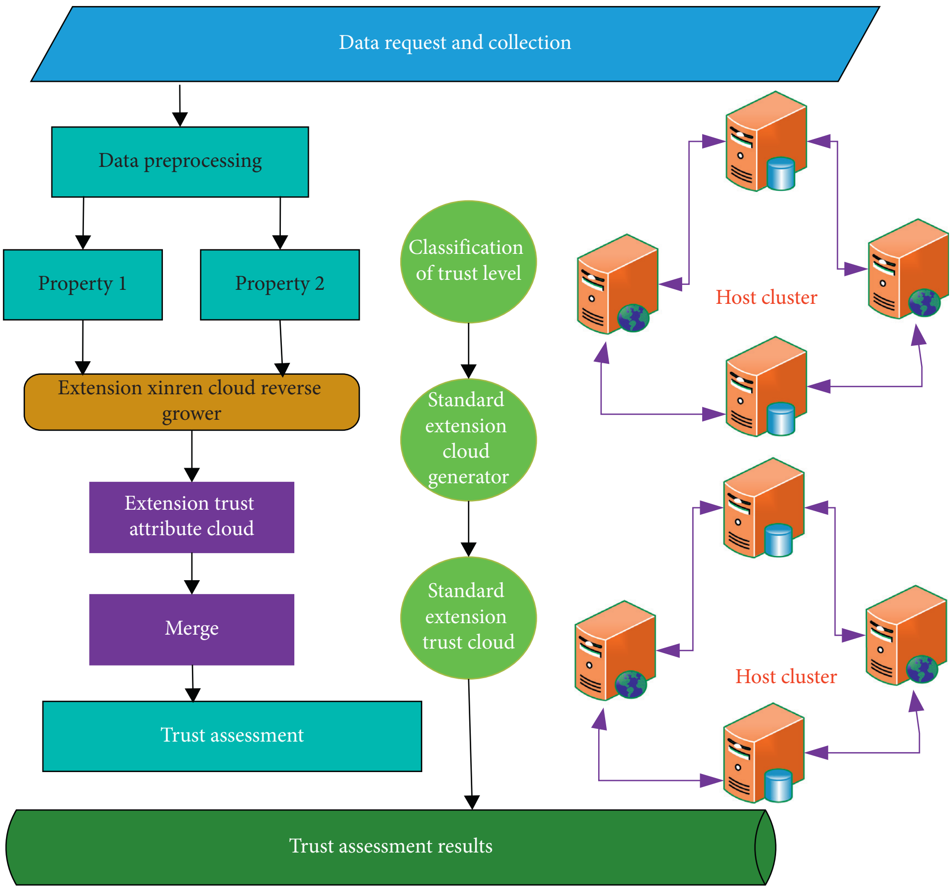

Figure 4: Trust evaluation model based on extension cloud.

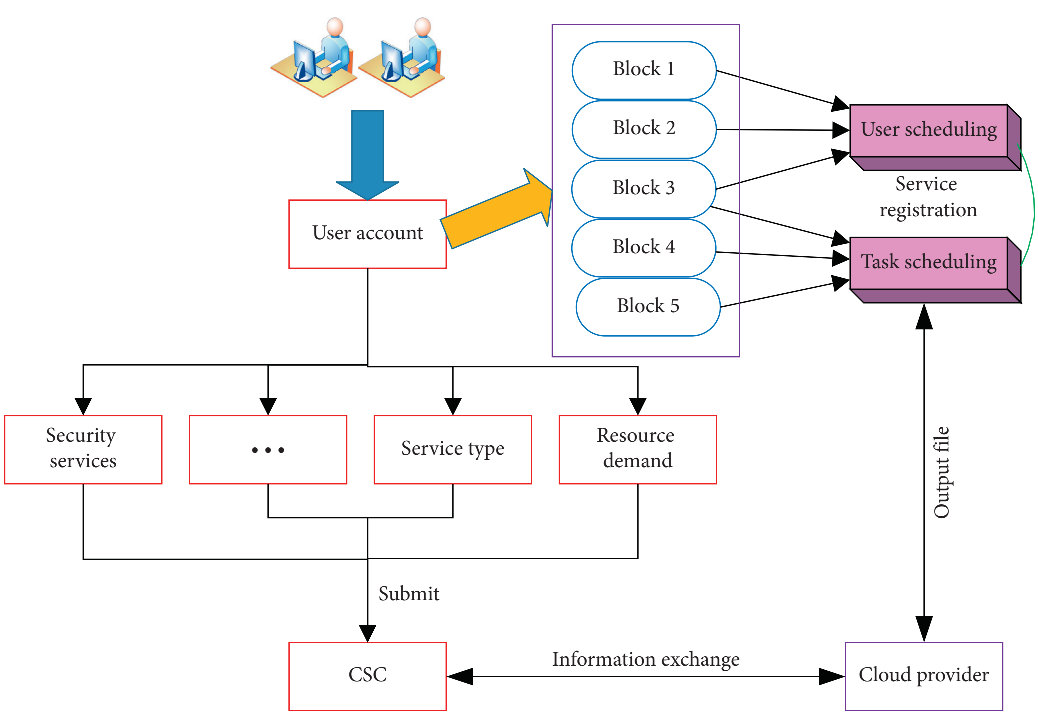

Figure 5: Scheduling algorithm flow.

cloud provider's service ability, and bind the cloud provider with high trust with the cloud user, so as to obtain useful service information. At the same time, cloud service providers also recommend useful resource links or publish cloud resource advertisements for users. In the whole resource scheduling, firstly, according to the user's actual requirements, select the cloud provider with high trust or bind the two and then use the service provider request list to allocate cloud service resources for users. In this process, cloud users are the core of the overall resource scheduling. In the task scheduling, firstly, according to the trust sensitivity coefficient of the user accessing the system tasks, select the satisfactory service resources in the cloud resource pool.

In the complex cloud environment, due to the limited use of cloud resources, the system submitted a lot of tasks, so it is very important to allocate reasonable cloud resources to users in the shortest time of waiting for access to ensure the completion of user tasks. In the case of fuzzy partition of cloud resources, when choosing a reasonable method to search for a matching resource path, due to different resource types, when searching for a reasonable resource, the resource pool will change with the change in the system environment.

This paper mainly describes the performance of cloud system resource scheduling by constructing the three-dimensional vector of "computing capacity network transmission capacity resource storage capacity." The performance of cloud system resources is further divided into $\mu_{\text{cmp}}, \mu_b, \mu_{\text{stori}}$. Among them, μ_{cmp} is the computing capability of cloud system resource performance, $\mu_b$is the communication capability of cloud resource performance, and μ_{stori} is the storage capacity of cloud resource performance.

According to the requirements of each performance of cloud system resources, the comprehensive performance value of cloud resources is calculated: in the formula, the parameters α, β, and γ represent the trust sensitivity coefficient of computing service capacity, bandwidth service capacity, and resource storage capacity, respectively:

$$\text{Rg} = \sqrt{\frac{\mu_{\text{cmp}}\alpha + \mu_b\beta + \mu_{\text{stori}}\gamma}{|\alpha + \beta + \gamma|}}. \quad (4)$$

According to the distance between the comprehensive performance of cloud system resources, the similarity of cloud resources can be calculated:

$$\text{Rg}_{ij} = \frac{\left|\text{Rg}_i + \text{Rg}_j\right|}{\left|\text{Rg}_i - \text{Rg}_j\right|}. \quad (5)$$

The mean value of the comprehensive performance resources was clustered by cloud system, where k represents the number of resource cluster. Comprehensive performance of cluster cloud system resources:

$$\mu_{\text{cmp}} = \frac{1}{k}\sum_{i=1}^{k}\left(\text{Rg}_{ij} + \Delta\delta\right). \quad (6)$$

The fuzzy c-means clustering scheduling method is proposed on the basis of conventional fuzzy partition considering the heavy weight factors. This method is mainly used to deal with a large number of resource data. The first mock exam is to set dataset μ_{cmp}, divide the dataset into C fuzzy resource blocks by using this algorithm, find every fuzzy partition clustering μ_{cmp} in dataset U, and make each cluster center point and the sample's nonsimilarity of each group reach a minimum value. The calculation of resource clustering function is as follows:

$$U\left(k, w_1, \ldots, w_m, t_1, \ldots, t_n\right) = \sum_{i=1}^{m}\sum_{i=1}^{n} d_{ij}\left(\text{Rg}_{ij} + \mu_{ij}\Delta\delta\right)^2. \quad (7)$$

In the fuzzy resource clustering function, M is the weighted index, $U(k, w, t)$ is the resource clustering midpoint of fuzzy block group i, and m, n is the minimum distance between the midpoint of the ith resource fuzzy clustering and the jth data node.

This method divides cloud system resource performance into three categories by a fuzzy mean resource clustering method. Firstly, the data of the central matrix are collected through the three-dimensional vector of "computing power network transmission capacity resource storage capacity," and the original data are initialized. Secondly, the cloud system resources are randomly divided into three categories, and the cloud resource cluster center is calculated; finally, each node in the cloud resource class is compared with the objective function to check the convergence, and a new fuzzy partition matrix is calculated.

4. Experiment and Analysis

At present, in the cloud environment, there are few resource scheduling algorithms based on cloud system, and the improved particle swarm optimization algorithm can realize the on-demand allocation of cloud service resources and improve the efficiency of resource scheduling, while the cloud service resource scheduling algorithm based on a Berger model can realize the reasonable allocation of resources. This paper proposes the tscfcars method, which not only considers the on-demand allocation of resources but also considers the fair allocation of resources; at the same time, it introduces trust sensitive mechanism in cloud user scheduling to obtain reliable services and provides an objective basis for cloud users to choose trusted cloud providers.

4.1. Experimental Design

4.1. Experimental Design. The cloud system simulation experiment includes six cloud service providers and N cloud users. The system is mainly composed of user scheduler, task generator, resource scheduler, and cloud interaction system. The system mainly uses cloud service providers as the main basis for domain division. The function of user scheduler is to bind cloud users and cloud providers automatically, while the function of resource scheduler is to generate random resource service nodes according to the number, performance, and difference of resource services and deploy node performance according to resource service nodes. The main function of the task scheduler is to bind the resources obtained by cloud users through the cloud information service center to the tasks in the task set. The main function of the cloud interaction system is as follows: first, request registration from the cloud information service center through the cloud service provider and obtain the service information of cloud users. Secondly, the user sends a request to the registration center and obtains the information of cloud provider indirectly, so as to achieve the purpose of interactive information. The simulation data of the simulation system mainly include cloud service providers, cloud service resources, and cloud resource pool sites. The data of each module are preprocessed, and its indicators are shown in Table 1.

The cloud virtual resource pool node in this paper mainly includes computing service node, cloud storage service node, and bandwidth service node. It initializes various indicators of cloud service virtual resource pool node from three aspects of computing capacity, transmission capacity, and storage capacity, as shown in Table 2.

According to the information of cloud users selecting cloud reliable service providers, firstly, the cloud users' demand for accessing cloud system tasks is considered from three aspects of computing type, storage type, and bandwidth type. Secondly, the calculation amount of tasks, bandwidth requirements of user access tasks, and various indicators of storage capacity are initialized, as shown in Table 3.

4.2. Experimental Result. In the cloud resource scheduling algorithm, because of the Berger model, the actual execution cost of the scheduling algorithm is large. If the tscfcars resource scheduling method, the Berger model-based resource scheduling method, and the improved particle swarm optimization resource scheduling method are compared, when the number of cloud tasks increases, the final task execution time of the resource scheduling algorithm under Berger model will show an upward trend. Therefore, this experiment will be divided into two stages according to the number of cloud users accessing cloud resources tasks for experimental comparison; that is, when the number of cloud users accessing cloud resources is large, the task completion time of tscfcars resource scheduling algorithm and improved particle swarm optimization resource scheduling algorithm is compared. The second is to compare the performance of the three resource scheduling models when the number of cloud users accessing cloud resources is small. The comparison of experimental results is shown in Figures 6 and 7.

According to the number of cloud users, the cloud task can be divided into two phases. One is to compare the task completion time of tscfcars resource scheduling algorithm with the improved particle swarm optimization algorithm when the number of cloud users accessing cloud resources is large. Second, when the number of cloud users accessing cloud resources is small, the cloud user satisfaction of the three resource scheduling algorithms is compared. The comparison of experimental results is shown in Figures 8 and 9.

The simulation results show that when the number of cloud tasks is small, tscfcars resource scheduling algorithm and improved particle swarm optimization resource scheduling algorithm have the same efficiency in the completion time of task execution and are better than the scheduling algorithm under the effect of Berger model. In terms of user satisfaction, tscfcars resource scheduling algorithm is equivalent to and better than the improved particle swarm optimization algorithm. When the number of cloud tasks is large, the tscfcars resource scheduling algorithm proposed in this paper is better than the improved particle swarm optimization algorithm and Berger model-based resource scheduling algorithm in terms of the completion time of cloud resource task execution and the user satisfaction of accessing cloud resource task. Therefore, the algorithm is reliable.

The idea of resource scheduling algorithm based on Berger model is to reasonably match the shortest distance resources between cloud information center and cloud service provider through calculation and provide them to cloud users. However, in the process of reasonable resource matching, the method of computing resource distance one by one to provide services for cloud users will result in high system resource cost and can not be used in real system. The improved particle swarm optimization (PSO) resource scheduling method is to continuously search for resources that meet the conditions in all cloud service resource systems, which can satisfy fewer cloud users in the shortest time, but can not meet the direct access of the whole cloud users.

The resource scheduling algorithm based on the Berger model improved particle swarm optimization algorithm considered by the operability of resources in cloud resource task execution. However, if the resource scheduling of the cloud node is honest or the resource scheduling is not considered, it will lead to the malicious resource scheduling. Therefore, it will also prolong the completion time of resource task execution and reduce user satisfaction. Aiming at the problems of the above two scheduling algorithms, this paper proposes tscfcars resource scheduling algorithm, which mainly adopts the customizable fuzzy clustering scheduling mode based on trust sensitivity. In this mode, trust-sensitive mechanism is added to the user scheduling module, which improves the transaction between cloud users and cloud providers to a certain extent and also prevents malicious nodes from attacking, thus effectively ensuring the reasonable scheduling between cloud service resources. In addition, in the task scheduling, the user's demand task is bound with the user's satisfied cloud service resources, which not only improves the completion time of task execution but also reflects the principle of cloud

Table 1: Evaluation indicators of cloud providers (unit/10^4).

Cloud service provider	Computing power	Transmission capacity	Storage capacity
ID1	7×10^2	3	3×10^2
ID2	5×10^2	5	2×10^2
ID3	2×10^2	2	3×10^2
ID4	7×10^2	3	2×10^2
ID5	5×10^2	5	3×10^2

Table 2: Indicators of each node of cloud service virtual resource pool.

Virtual resource type	Computing power (10^4)	Transmission capacity (10^2)	Storage capacity (10^2)
Computational	$(2\sim6)\times10^2$	0.6~2.6	$6.5\sim3.3\times10^2$
Storage type	2~6	0.6~2.6	$65\sim3.3\times10^3$
Broadband type	2~6	6~26	$6.5\sim3.3\times10^2$

Table 3: Indicators required by cloud users to perform system tasks (MB).

Virtual resource type	Computing power (10^2)	Transmission capacity	Storage capacity
Computational	60~200	30~60	30~140
Storage type	6~30	3~6	300~1400
Broadband type	6~30	300~600	30~140

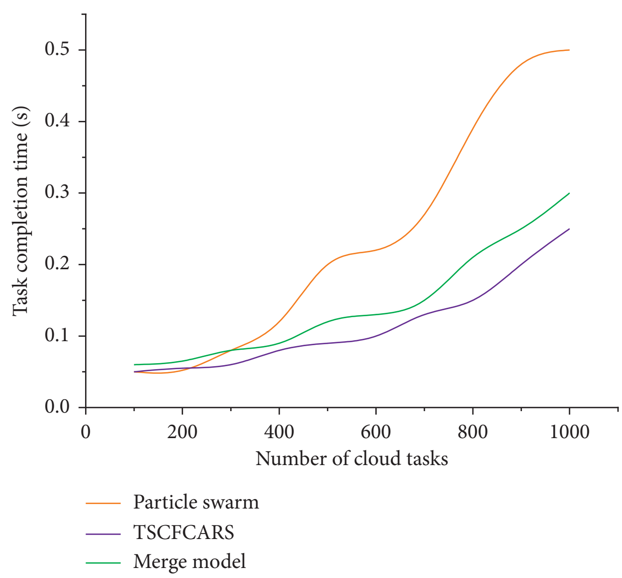

Figure 6: Comparison of scheduling time when there are many cloud service tasks.

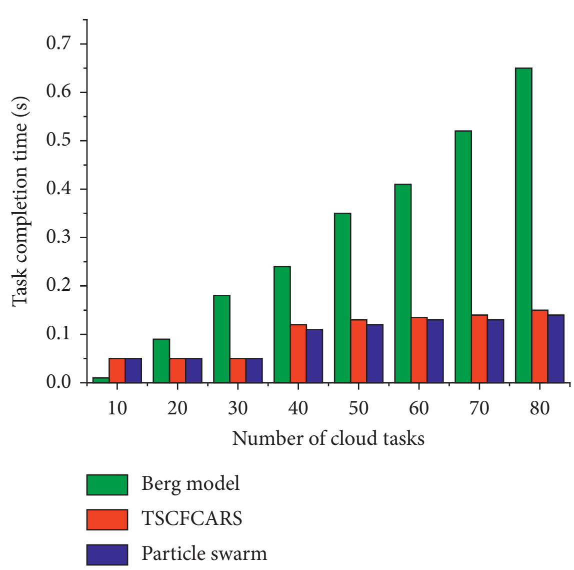

Figure 7: Comparison of completion time when cloud service execution is small.

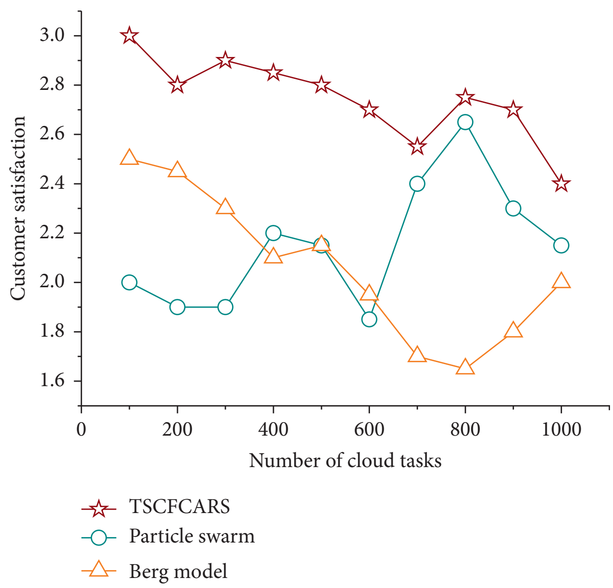

Figure 8: Comparison of user satisfaction with cloud service tasks.

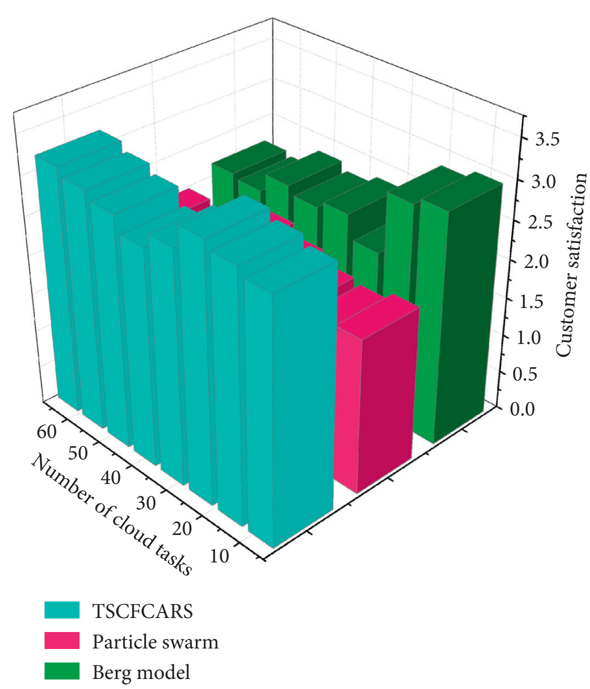

Figure 9: Comparison of user satisfaction with fewer cloud service tasks.

resource task allocation on demand. Therefore, the customizable fuzzy clustering scheduling method with trust sensitivity has good timeliness and security.

5. Conclusion

In order to solve the trust problem and resource scheduling problem between entities in cloud service environment, this paper mainly studies the service trust evaluation model of extension cloud theory and cloud resource scheduling optimization under trust sensitivity. Firstly, aiming at the trust problem existing in the transaction process between cloud users and cloud providers, this paper combines cloud model with extension theory and introduces trust-sensitive mechanism, proposes a service trust evaluation method of extension cloud, and applies it to cloud transaction to ensure fair transaction between cloud provider and cloud user. Secondly, aiming at the resource optimization problem between users and cloud providers in cloud environment, a trust-sensitive customizable fuzzy clustering cloud resource scheduling method is proposed. By using this method, cloud resource scheduling is divided into two aspects: cloud user resource scheduling and cloud task resource scheduling, so as to ensure the reliability and security of user scheduling and the rationality of cloud task scheduling. Finally, the effectiveness of the new method is verified by simulation. There are some differences between simulation environment and real construction environment. The future research plan is to build a real cloud environment to test and verify the model.

Data Availability

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

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

This work was supported by the Doctoral Fund Project of Shandong Jianzhu University (The Effects of Word-of-Mouth Information Characteristics on Consumer Confusion) (X19075Z0101).

References

[1] H. Wei and P. Qiao, "The CMA-ES algorithm for resource scheduling in cloud computing," *Ce Ca*, vol. 42, no. 5, pp. 2005–2012, 2017.

[2] S. Rubab, M. F. Hassan, and A. Mahmood, "QoS based multi-constraints bin packing job scheduling heuristic for heterogeneous volunteer grid resources," *The International Arab Journal of Information Technology*, vol. 16, no. 4, pp. 661–668, 2019.

[3] H. Sun, H. Yu, and G. Fan, "Contract-based resource sharing for time effective task scheduling in fog-cloud environment," *IEEE Transactions on Network and Service Management*, vol. 17, no. 2, pp. 1040–1053, 2020.

[4] W. Lee, M. Kim, and Y. Kang, "Nursing and medical students' perceptions of an interprofessional simulation-based education: a qualitative descriptive study," *Korean Journal of Medical Education*, vol. 32, no. 4, pp. 329–341, 2020.

[5] J. Bruce, "Cloud HPC makes simulation-driven design optimization more accessible," *Desktop Engineering*, vol. 22, no. 3, pp. 12-13, 2016.

[6] A. Ikram, A. Anjum, and N. Bessis, "A cloud resource management model for the creation and orchestration of social communities," *Simulation Modelling Practice and Theory*, vol. 50, no. 3, pp. 130–150, 2015.

[7] H. Cornelius, S. Zhichao, and R. M. Oliveira, "Knowledge-aided informed dynamic scheduling for LDPC decoding of short blocks," *IET Communications*, vol. 12, no. 9, pp. 1094–1101, 2018.

[8] N. Grozev and R. Buyya, "Performance modelling and simulation of three-tier applications in cloud and multi-cloud environments," *The Computer Journal*, vol. 58, no. 1, pp. 1–22, 2015.

[9] R. Zhang, K. Wu, M. Li, and J. Wang, "Online resource scheduling under concave pricing for cloud computing," *IEEE Transactions on Parallel and Distributed Systems*, vol. 27, no. 4, pp. 1131–1145, 2016.

[10] A. Veremyev, V. Boginski, and E. L. Pasiliao, "Potential energy principles in networked systems and their connections to optimization problems on graphs," *Optimization Letters*, vol. 9, no. 3, pp. 585–600, 2015.

[11] D. C. Corredor, J. José Luis Cuadra Díaz, J. Javier José Mateos et al., "Self-management model in the scheduling of successive appointments in rheumatology," *Reumatologia Clinica*, vol. 15, no. 6, pp. 333–337, 2018.

[12] M. K. Mehlawat, P. Gupta, and W. Pedrycz, "A new possibilistic optimization model for multiple criteria assignment problem," *IEEE Transactions on Fuzzy Systems*, vol. 26, no. 4, pp. 1775–1788, 2018.

[13] S. Fang, Y. Zhu, L. Xu et al., "An integrated system for land resources supervision based on the IoT and cloud computing," *Enterprise Information Systems*, vol. 11, no. 1–5, pp. 105–121, 2017.

[14] Z. Yifan and Y. Dongliang, "Risk management of PPP project based on big data algorithm based on cloud," *IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association*, vol. 30, no. 7, pp. 541–545, 2018.