Conflict Coordination Method of Heterogeneous Educational Resources Sharing Based on Blockchain

Jiang Li, Xiao-tian Yang, and Fei Gao(✉)

Tibet University School of Information Science and Technology, Lhasa 850000, China

Abstract. In order to improve the resolution of resource sharing conflicts, a blockchain-based heterogeneous education resource sharing conflict coordination method is proposed. Build a distributed mobile agent dynamic collaboration network based on blockchain to provide a new distributed computing model. Design the process of the distributed mobile dynamic collaboration network, including the system process of "create" behavior, the system process of "invite" and "accept/reject" behavior, the system process of "update" and "complete" behavior, the system process of "query" and the "response" behavior system process. Based on the distributed mobile dynamic collaboration network, the conflict coordination model of heterogeneous education resource sharing is designed to realize the conflict coordination in heterogeneous education resource sharing. Through comparative experiments, it is verified that the conflict resolution degree of this method is higher than that of traditional methods, and the conflict coordination performance is improved.

Keywords: Blockchain · Heterogeneous educational resource sharing · Conflict coordination · Mobile agent

1 Introduction

To realize the sharing of high-quality education resources among colleges and universities can alleviate the shortage of high-quality education resources, improve the overall quality and level of education in Colleges and universities, and also enable colleges and universities in the new situation to continuously explore new development and seek new breakthroughs in the sharing of high-quality education resources [1, 2]. Research on the methods of sharing conflicts of heterogeneous educational resources can promote the improvement of high-quality educational resource sharing measures in colleges and universities, and further promote the development of higher education. However, there are often conflicts in the sharing of heterogeneous educational resources, so the coordination has become a key research issue in the sharing of heterogeneous educational resources [3].

At present, the coordination and resolution of resource sharing conflicts mainly include the governance method of regional water resources sharing conflicts from the

W. Fu et al. (Eds.): eLEOT 2021, LNICST 390, pp. 218–229, 2021.
https://doi.org/10.1007/978-3-030-84386-1_18

perspective of policy network theory. Based on the theoretical perspective of policy networks, the discussion of regional water resources sharing conflicts is carried out. By clarifying the main body of the governance network of regional water resources sharing conflicts, analyze the interaction and behavior of intergovernmental networks and issue networks involved in the policy process. Apply the policy network theory to the process of regional water resources sharing conflict management, and explore how the network subjects play a role in the process of policy formulation and implementation through network analysis. Research on context aware based association analysis and recommendation model of learning resources, combined with context aware technology and multi-level, multi relationship association algorithm to realize personalized recommendation of learning resources, explored the process of behavior feature analysis and extraction based on context aware, and elaborated the mechanism based on context description and association recommendation, In order to improve the quality and effect of resource sharing service. Although the above methods can achieve resource sharing coordination, there is a problem of low conflict resolution.

In order to solve the problems existing in traditional methods, the blockchain is applied to the research of conflict coordination of heterogeneous educational resources sharing, and a new method based on block chain is proposed. The innovation points of this method are as follows:

(1) In order to provide a new distributed computing model, the dynamic cooperation network of distributed mobile agents is constructed based on blockchain technology.
(2) The process of distributed mobile dynamic collaboration network is designed, and the conflict coordination model of heterogeneous educational resource sharing is designed to realize the conflict coordination in heterogeneous educational resource sharing.
(3) Through comparative experiments, it is verified that the conflict resolution degree of this method is higher than that of traditional methods, and the performance of conflict coordination is improved.

2 Blockchain-Based Heterogeneous Education Resource Sharing Conflict Coordination Method

2.1 Construction of Distributed Mobile Dynamic Cooperation Network

The distributed mobile agent dynamic collaboration network is constructed based on the blockchain to provide a new distributed computing model. In this model, each mobile agent represents a mobile user. The mobile agent is in the wireless communication network and the intelligent mobile terminal. With the support, it will have the ability to perceive changes in the environment, service resources and their changes, and to make independent decisions and communicate with each other [4].

In the dynamic cooperative network model of distributed mobile agent, the agents involved in computing can be divided into two types: Mobile (user) agent and service (provider) agent. Among them, the service agent is static, it only publishes the service plan, accepts the service reservation and the scheduled change; the mobile agent is

different from the service agent, it first formulates the itinerary plan based on the personal goal and the related service agent's service reservation, on this basis, it cooperates with other mobile agents, dynamically optimizes its own travel plan, and according to the travel plan, it changes the service plan from one to the other. When a location moves to another location, the mobile agent has the ability of cooperative optimization and mobility.

The dynamic cooperation and optimization capability between mobile agents is the main feature of the distributed mobile agent cooperation network model, which increases the flexibility and complexity of computing [5]. In order to distinguish each other, all mobile agents have a globally unique identifier, and it will not change during its life cycle.

Life Cycle Design of Mobile Agent

Whether it is a service agent or a mobile agent, they enter its cycle cycle from the beginning to the end when they are created. The life cycle of an agent defines its different life states and the transition states between states [6]. The difference is that mobile agents can take the initiative to enter the migration state. In the distributed mobile environment, in order to facilitate one mobile agent to confirm whether it can invite another related mobile agent to join the dynamic cooperative network, the life cycle of mobile agent is divided into the following five states:

(1) Initial state: When the mobile agent enters the wireless network environment and is created, it enters the initial state. The mobile agent in the initial state can either choose to develop a personal action plan or leave the mobile environment. If a mobile agent has formulated a personal action plan, its state will automatically migrate to the cooperative state; if it chooses to leave the mobile environment, its state will automatically migrate to the offline state.
(2) Cooperative state: A mobile user in a cooperative state indicates that this user hopes to establish a dynamic collaboration network with other mobile users to improve their personal action plan according to a collaboration strategy. When a mobile user initiates a creation or has joined a dynamic collaboration network, its state will automatically migrate to the locked state; if it does not want to cooperate with other mobile users, it can change its own state to a satisfied state or an offline state [7].
(3) Locked state: If a mobile user is in a locked state, it indicates that it is cooperating with other mobile users in a dynamic collaborative network. Until it exits the current collaboration network, it cannot join other dynamic collaboration networks. When it exits the current collaboration network, its status will automatically shift to a cooperative state.
(4) Complacency: complacency indicates that current mobile users do not expect to cooperate with other users at the moment. Mobile users in the satisfied state will refuse to join all dynamic collaboration networks unless they re migrate their personal status to cooperative state.
(5) Offline state: indicates that the user has left the mobile environment and the life cycle has ended.

The five state transition diagram reflects the changes and relations among the five states in the mobile agent life cycle. The five state transition diagram is shown in Fig. 1 below.

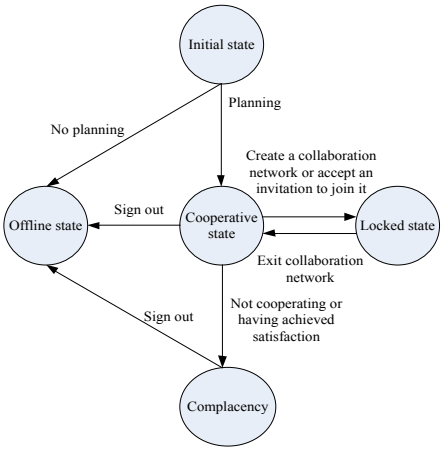

Fig. 1. Five state transition diagram

Design of Interaction Mode Between Mobile Agents

In its life cycle, mobile agent needs to interact with the external environment, which includes not only the interaction between mobile agents, but also the interaction between mobile agents and service agents. In order to express its interactive semantics, the following communication modes and message modes are formulated.

Create: Mobile users create a dynamic collaboration network.

Invitation: Invite relevant mobile users to join a dynamic collaboration network created by sharing a variable.

Accept/Reject: Mobile users accept/reject invitations from other mobile users to join a dynamic collaboration network.

Update: In the dynamic collaboration network, notify its sub-node users to modify their personal action plan.

Completion: In the dynamic collaboration network, notify the parent node user that he has completed the modification of his personal action plan.

Exit: Indicates that the mobile user is ready to exit the current dynamic collaboration network.

Inquiry: Indicates that the current mobile user wants to learn about the reservation of the service plan from a certain service provider, and can also inquire about the actual mobile users that affect the current mobile user plan.

Response: Indicates that the service provider is responding to a mobile user's inquiry request for service plan reservations or other related information [8].

Message Pattern Design

The message mode between mobile agents is designed, that is, the message transmission format is: nameID: State:Action.

The message passing format between service provider and mobile agent is: nameID: action.

Among them, nameID represents the ID of the mobile agent participating in the cooperation or the ID of the service provider, state represents a certain state of the mobile agent in five states, and action represents the actions that the agent in a certain state can perform and the action that the service provider can perform. For example, at this time, a message passing format is agent 1: Cooperative State: accept/reject, which indicates that mobile agent 1 is in cooperative state at this time. It can accept or reject the invitation sent by other mobile users to join a dynamic collaboration network. The cooperative mobile agent can perform the create and accept/reject operations respectively, and the locked mobile agent can perform the invitation and exit operations.

2.2 Network System Process Design

Design the process of the distributed mobile dynamic collaboration network, including the system process of "create" behavior, the system process of "invite" and "accept/reject" behavior, the system process of "update" and "complete" behavior, the system process of "query" and The "response" behavior system process.

Combined with the mobile user life cycle state, the system flow chart under different interaction behavior states can be obtained. The "create" behavior is sent by mobile users. Because they share a certain variable, the mobile users in the cooperative state send a message of "create" dynamic collaboration network to the service provider, requesting to create the network for cooperation [9]. The system flowchart of the create behavior is shown in Fig. 2.

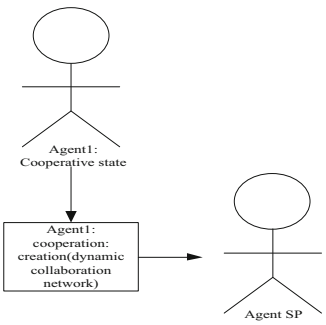

Fig. 2. System flow chart of "create" behavior

When a mobile user is in a "cooperative state", because a certain variable is shared, the relevant mobile user of this variable can be invited (at this time, the relevant mobile user

must be in the cooperative state to send the invitation) to join the created collaboration network. After weighing, the relevant mobile user can choose to "accept" or "reject" the invitation. If the invitation is accepted, the relevant mobile user can use the The user status is set to "locked", otherwise it is still cooperative. The behavior system flow chart of "invite" and "accept/reject" is shown in Fig. 3.

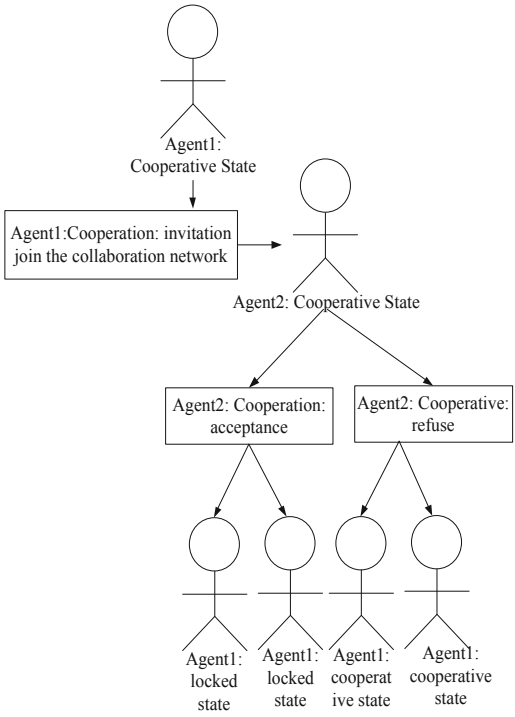

Fig. 3. "Invite" and "Accept/Reject" behavior system flowchart

The mobile user in the locked state sends the "update" message of the shared variable to the relevant mobile users participating in the cooperation in the collaborative network platform that affect the shared variable. After the relevant mobile user accepts the update, the service provider modifies the relevant information and will "complete" The information is sent to the mobile user, and after the mobile user information is updated, the respective status is set to the cooperative state. The system flowcharts of "update" behavior and "complete" behavior are shown in Fig. 4 and Fig. 5 below, respectively.

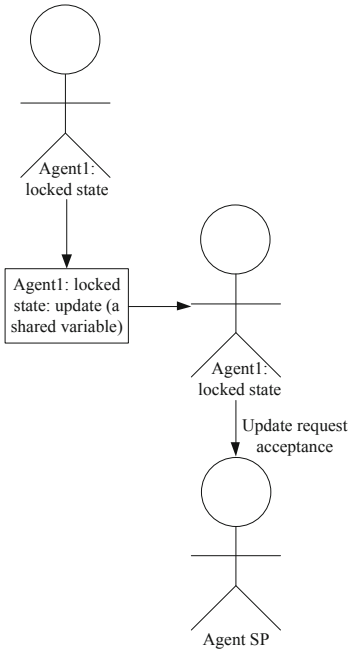

Fig. 4. Flow chart of "update" behavior system

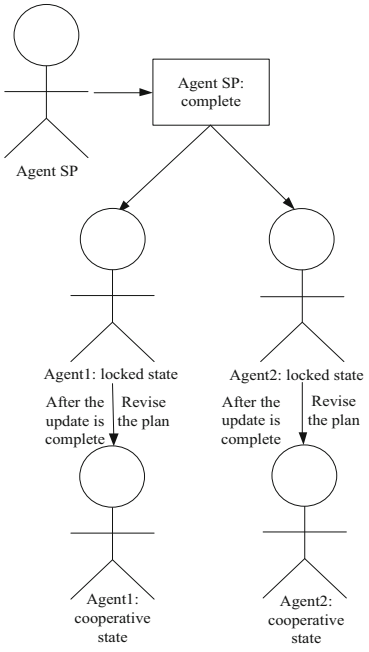

Fig. 5. "Complete" behavior system flowchart

When mobile users are in a cooperative state, they can query the service provider for information about mobile users that affect a certain shared variable and other service reservations, and the service provider will also send a response message to the mobile users regarding relevant information. The flow chart of the "query" and "response" behavior system is shown in Fig. 6 below.

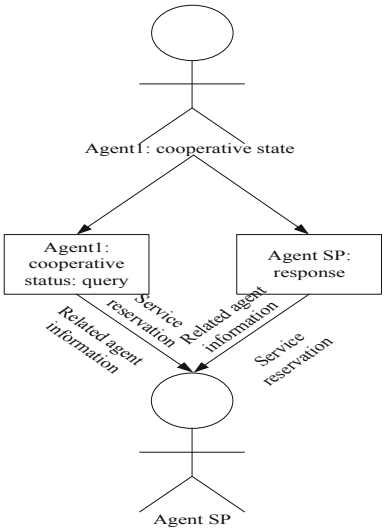

Fig. 6. Flow chart of "query" and "response" behavior system

2.3 Conflict Coordination

Based on the distributed mobile dynamic collaboration network, the conflict coordination model of heterogeneous education resource sharing is designed to realize the conflict coordination in heterogeneous education resource sharing. The conflict coordination model of heterogeneous educational resources sharing is composed of resource working state monitoring module, resource life cycle management module, resource conflict coordination management module and event processing module.

Resource Working Status Monitoring Module

The resource working state monitoring module is connected to the equipment resources in the system. No matter what kind of equipment resource, it will have its working state, and can use the finite state machine to describe the working state model. The resource working state monitoring module is based on the finite state machine, According to the resource's working state transition diagram, to monitor the working state of the allocated resources, because the state of the resource is dynamic and may change at any time, so it can be monitored and updated in real time to facilitate the life of the resource The cycle management module and conflict management module are used as reference [10]. The application developer models the resource state machine, which is related to the

application. After the modeling, the custom state machine code is generated. On the one hand, it reduces the workload of the application developer and reduces the difficulty. On the other hand, it standardizes development standards and facilitates RSM. Unified management.

Resource Lifecycle Management Module

The resource life cycle management module is mainly responsible for the allocation, searching, adding and deleting resources of sharing heterogeneous educational resources, as well as reminding of resource conflicts. The most important part is the acquisition, allocation and release of resources. The resource life cycle management module also records the operation of the currently allocated and shared heterogeneous educational resources, monitors which applications occupy the allocated resources and the time allocated to the applications, and contacts the resource working status detection module to detect whether the resource has completed the task, and can send a message to inform the lifecycle manager to release the resources. The application sends out the use resource message and applies for resources to the lifecycle manager module. The lifecycle manager finds the resources that can realize its functions, including idle and allocated resources. If there are idle resources directly allocated and no idle resources are available, the resource lifecycle management module allocates the allocated resources to the application for reuse according to the resource status monitoring and conflict detection.

In view of the limited resources of the physical world, applications connect multiple underlying resources, and resource connections that are no longer needed or completed tasks should be released to ensure the stability of the model and ensure that other applications can complete tasks. Therefore, resources must be Manage complex life cycle scenarios. The solution used is to separate resource use from resource management and add an independent life cycle manager, which is only responsible for managing and maintaining resources.

Resource Conflict Coordination Management Module

The resource conflict coordination management module is responsible for the inspection and resolution of conflicts in the sharing of heterogeneous educational resources. For time-triggered control, the order of tasks in the queue can be preset according to the order of time, and control messages can be sent to control resources when the specified time is reached. This is a progressive control method. By allocating resources according to the overlap in time, avoid conflicts. Moreover, due to the complexity of the physical world, time-triggered control is not enough to change and control the physical world truly and effectively, and the time description is too absolute. If you simply consider the absolute time, the expected effect may not be achieved, and the application is easy Resources are released. At the same time, in event-driven control, the order of scheduling resources is often unknown and unreliable.

In the event triggered control, the action command after the event is triggered is put in the queue, and whether the action command can be executed is determined according to the running state and usage of the current resource. If the model is judged as a conflict event in the detection process, the analysis record is saved, and the mixed preemption strategy of resource resolution is called to schedule the tasks. The tasks that fail to preempt the resources and the tasks that are preempted are saved to the queue. After

the resources are released, the tasks with high priority in the queue are scheduled. If the new task successfully preempts the resources, it will execute the previously saved action commands to deal with random events in real time, which ensures the ability to dynamically coordinate resources.

Event Processing Module
The event processing engine mainly consists of three parts: event collector, event sender, and event handler. The event handler processes the subscription to the event from the application, the event collector responds to the triggered event, and the event sender sends notifications to the application that has subscribed to the corresponding message. At the same time, after the conflict is resolved, the model uses the event processing engine to send notification messages to the applications that are preempted resources.

3 Conflict Coordination Experiment

3.1 Experimental Design

In the experiment, five universities were selected as samples to obtain their heterogeneous educational resource sharing and conflicts. The five selected colleges are D colleges, H colleges, J colleges, K colleges, and G colleges. These colleges are all in a densely populated area with certain shared practices, and the colleges are of different types.

In the experiment, the cooperation depth of dynamic collaboration network is set to 3, and the maximum number of sub nodes allowed under each node is 3.

In the experiment, several universities use the same network to share heterogeneous educational resources. The network topology of each university is shown in Fig. 7.

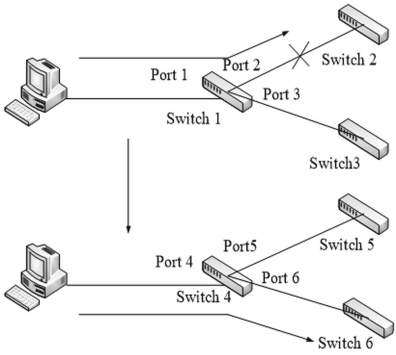

Fig. 7. Network topology deployed by each university

Use the blockchain-based method of heterogeneous educational resource sharing conflict coordination to coordinate conflicts in the sharing of heterogeneous educational resources in several universities, and obtain the conflict resolution data as experimental data. In order to make the experimental results comparable, the method of heterogeneous educational resource sharing conflict coordination based on situational awareness is used

as the comparative method in the experiment to conduct comparative experiments. Also obtain the conflict resolution data of the heterogeneous educational resource sharing conflict coordination method based on context awareness as the comparative experimental data.

3.2 Experimental Result

The experimental data of the conflict resolution comparison between the blockchain-based heterogeneous educational resource sharing conflict coordination method and the context-aware heterogeneous educational resource sharing conflict coordination method are shown in Table 1.

Table 1. Comparative experimental data of conflict resolution

Proportion of conflict resources (%)	Conflict resolution rate (%)	
	Method based on blockchain	Context-based approach
2	98.36	92.01
4	98.29	91.98
6	98.25	91.98
8	98.22	91.97
10	98.21	91.97
12	98.19	91.95
14	98.18	91.90
16	98.18	91.89
18	98.16	91.89
20	98.15	91.88
22	98.12	91.86
24	98.10	91.84
26	98.07	91.84
28	98.02	91.83

According to the data in Table 1, with the gradual increase in the proportion of conflict resources, the conflict resolution of the method in this paper and the traditional method has shown a gradual decrease, but the conflict resolution of the method in this paper is significantly higher than that of the traditional method. The maximum value of resolution is 98.36% and the minimum is 98.02. The maximum value of conflict resolution of traditional methods is 99.01%, and the minimum is 91.83. Through the comparison, it can see that the method in this paper has a stronger ability to coordinate the sharing conflicts of heterogeneous educational resources.

4 Conclusion

Research on the methods of sharing conflicts between heterogeneous educational resources can promote the improvement of high-quality educational resource sharing measures in my country's universities and further promote the development of higher education. In this context, a blockchain-based method for coordinating heterogeneous educational resource sharing conflicts is proposed. The experimental results show that this method has improved the degree of conflict resolution, which is of great help to the improvement of the degree of heterogeneous educational resource sharing.

References

1. Fu, W., Liu, S., Srivastava, G.: Optimization of big data scheduling in social networks. Entropy **21**(9), 902 (2019)
2. Liu, S., Li, Z., Zhang, Y., et al.: Introduction of key problems in long-distance learning and training. Mob. Netw. Appl. **24**(1), 1–4 (2019)
3. Liu, S., Bai, W., Zeng, N., et al.: A fast fractal based compression for MRI images. IEEE Access **7**(99), 62412–62420 (2019)
4. Guo, S., Hu, X., Zhou, Z., et al.: Trust access authentication in vehicular network based on blockchain. China Commun. **16**(6), 18–30 (2019)
5. Zhong, L., Wu, Q., Xie, J., et al.: A secure large-scale instant payment system based on blockchain. Comput. Secur. **84**(7), 349–364 (2019)
6. Alcarria, R., et al.: A blockchain-based authorization system for trustworthy resource monitoring and trading in smart communities. Sensors **18**(10), 3561–3561 (2018)
7. Li, M., Shen, L., Huang, G.Q.: Blockchain-enabled workflow operating system for logistics resources sharing in E-commerce logistics real estate service. Comput. Ind. Eng. **135**(12), 950–969 (2019)
8. Yilong, Y., Quan, Z., Peng, L., et al.: MicroShare: privacy-preserved medical resource sharing through microservice architecture. Int. J. Biol. Sci. **14**(8), 907–919 (2018)
9. Michiel, A.J., Veldman, J., Fazi, S., et al.: Evaluating resource sharing for offshore wind farm maintenance: the case of jack-up vessels. Renew. Sustain. Energy Rev. **109**(7), 619–632 (2019)
10. Zhao, B., Meng, D., Hou, R., et al.: Venice: an effective resource sharing architecture for data center servers. ACM Trans. Comput. Syst. **36**(1), 1–26 (2019)