

Research on online teaching platform system based on microservice architecture

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Abstract. The traditional online teaching adopts the single architecture to develop and implement the system, which facilitates the data sharing and testing of the system. However, due to the increasing complexity of the system's business functions, the system based on monolithic architecture has become increasingly complex, its scalability has deteriorated, and its concurrency performance has decreased. Based on these problems, this paper puts forward combining microservice architecture and online teaching platform, using microservice architecture independent deployment, concurrent performance characteristics such as high technology selection and flexible, the complex business function is divided into several small service module, solve the challenges faced by the traditional system, at the same time improve the efficiency of the use of online teaching platform and students' learning autonomy, The system function design, architecture design, safety design and so on are expounded to build an efficient and perfect online teaching platform.

Keywords: Online teaching, Microservice architecture, Independent deployment.

1 Introduction

Online teaching is a new teaching method emerging in recent years. It combines education with network through Internet technology, which breaks the traditional teaching method and makes learning free from the constraints of time and place of class. However, with the increasing amount of information of teaching resources and the increasingly complex business needs of users, the teaching efficiency of the traditional online teaching platform system is gradually decreasing and the expansion ability of the system is also becoming low, which makes the user's page experience feel worse, it can no longer meet the business needs of online teaching, in this context, the software system with high concurrency, demand expansion and independent deployment based on microservice architecture is gradually becoming the mainstream system ^[1]. Therefore, this paper proposes an online teaching platform based on microservice architecture.

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Microservice architecture is an architectural theory proposed by Martin Flower, whose core idea is to divide the complex business functions contained in a system into independent multiple microservices, each microservice for a specific function, and the communication between each service usually adopts HTTP/API lightweight protocol [2]. Using microservice architecture change greatly to small, the complex as a simple way for the development and deployment system, it will be complicated business system according to the function different divided into multiple small services, each service is only responsible for division within the scope of the function modules, can choose different in the range of technology development, not only make the function of service is more clear, moreover, it is convenient for us to deploy and test the system separately, which reduces the amount of code for developers and facilitates the maintenance and function expansion of the system in the later stage [3,4,5]. By combining the microservice architecture with online teaching, the efficiency of the online teaching platform and students' autonomous learning ability can be improved by taking advantage of its independent deployment, high concurrency and flexible technology selection, etc. At the same time, the utilization rate of the system can be improved according to the advantages of the microservice architecture expanding according to demand. The microservice architecture is shown in figure 1.

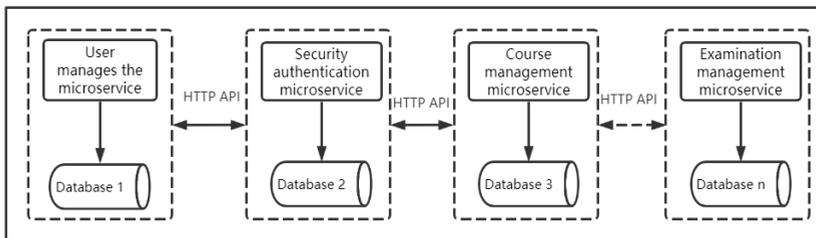


Fig. 1. Microservice architecture diagram.

2 Present situation of online teaching

Online education is a new teaching way, it will be a variety of computer technology and classroom knowledge together, formed the online teaching platform system, it has advantage than traditional offline teaching, using the Internet to effective dissemination of knowledge, can to bring the content of the textbook is no online classroom, can not only broaden the students' knowledge, at the same time can improve the quality of teaching, promoting students' learning initiative [6,7]. However, with the progress of science and technology and the continuous development of education, the traditional online teaching platform system gradually can not meet the complex business needs of users, and then some difficulties appear. The first point is that the traditional online teaching platform is based on the development and construction of a single architecture system. Single architecture is a whole application, it all business function modules are written in a project, so that the relationship between system hierarchical call is not clear, the business hierarchical boundary is blurred, part of the business functions can not be extended, improve the complexity of the system; moreover, it is difficult to introduce new technology into the system to improve the operating efficiency of the system. The front-end technology used in the system is fixed, which increases the code repetition rate of the system and reduces the scalability of the system [8]. The second point is that the traditional online teaching platform system operates in the cloud environment by creating virtual machines, which reduces the maintainability of the system. At the same time, if there is a problem in the system, it is impossible to seek help from the cloud environment, but system developers can only solve it by themselves [9]. With online teaching platform of the third point is widely used, the

number of users using the system will gradually increase, at the same time, the data information of system corresponding increase, in the basis of monomer architecture bear ability may exceed the load capacity of the system, the system of concurrent performance, this will lead to system lag, slow progress, and even make the whole system doesn't work. Fourthly, the traditional online teaching method is too rigid and cannot be flexibly changed. Although online teaching transcends time and place, the lack of face-to-face communication and interaction between teachers and students cannot guarantee students' independent learning.

Based on these problems, this paper proposes to combine the microservice architecture with the online teaching platform, and take advantage of the advantages of the microservice architecture such as flexible deployment, scalability on demand, load balancing and high concurrency in the cloud environment to solve these problems, which not only improves the efficiency of students' independent learning, but also strengthens the interaction and communication between teachers and students. At the same time, the online teaching platform will develop in a more scientific and efficient way.

3 The system design of online teaching platform

3.1 System functional design

The online teaching platform designed by this system is mainly divided into front end and back end. The front end function is oriented to students, while the back end function is oriented to teachers and administrators. The system functional structure is shown in figure 2.

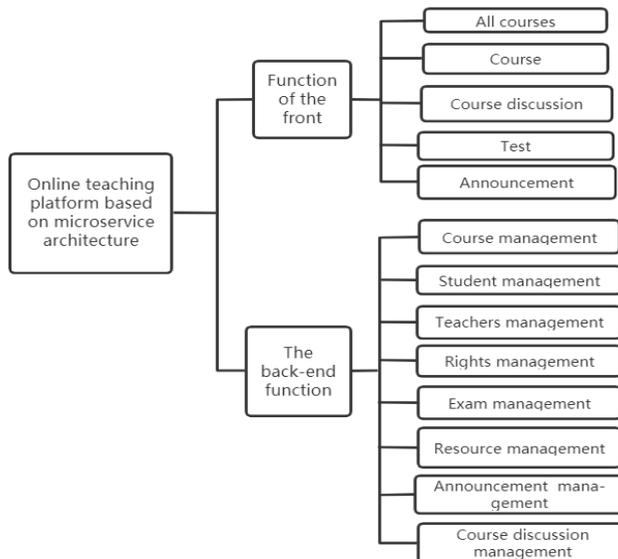


Fig. 2. System functional structure diagram.

The front end of the system is used by students, mainly to facilitate students in online class, course testing, online examination, course discussion and so on. The front-end function is mainly divided into five functional modules, which are the whole course, course learning, course discussion, examination and announcement. All courses include all courses of all majors. You can add the learned courses to the course learning by searching the course number. The course learning contains the list of courses to be studied, the list of course tests and the list of course seminars. The course list contains all the courses to be

studied; course test refers to the small test issued by the teacher for the course, which is used to check the students' learning level of the course. Course discussion includes course discussion and free discussion. Course discussion is issued by the teacher and requires the active participation of students. The free discussion can be initiated by both teachers and students. If students have questions about this course, they can put forward their own questions, and the teachers and students can discuss the questions together. The examination function is that the teacher issues the course examination in the back end, and the students take the online examination according to the examination time. After the completion of the examination, the students can view the examination content and examination results, etc. Announcements include notices and feedbacks. If students have questions about the system or some system function is wrong, they can leave a message and give feedback on the feedback page.

The back-end function of the system is used by teachers and administrators. There are six main functional modules of teachers, including course management, student management, examination management, resource management, announcement management and course discussion management. Course management includes course creation, course list management and course discussion. There are fixed templates in course creation, which teachers can modify according to personal needs. Course videos, course tests and course discussions can be added to the course templates. At the same time, the teacher can also change the class to live class, so that the teacher and students can conduct synchronous discussion and strengthen the communication between teachers and students. Student management includes the basic information of students and the information of students' courses, the basic information of students is the basic information of students who choose this course, such as student number, name, gender, major and so on. Test management includes tests, test scores and all tests. In the test function, the teacher can choose whether to turn on the camera during the test to synchronize students' test conditions. Resource management refers to the course resources of each course. Some teaching resources available for download are provided in the system. Teachers can also upload the teaching resources of the course through other channels, which is convenient for teachers to use in the course management. In announcement management, teachers can issue announcements related to the course to remind students of the progress of the course. In course discussion management, teachers create course discussions to remind students to prepare the content before the next class in advance or review the content explained in class after class. Compared with the teacher function, the administrator function has more teacher management and authority management module. Teacher management includes all teachers and teacher course management, administrators can manage all teachers' basic information and teachers' courses. The administrator can import the basic information of teachers in batches or create the information of teachers individually. Teachers' courses can be created in batches by administrators or individually by teachers. The authority management has all the authority and the distribution authority, the administrator manages all the authority, at the same time according to the need can add, delete or modify the authority; assign permission function is that administrators assign different permissions to teachers according to their different levels, so that teachers can carry out different business operations.

3.2 System architecture design

This system is developed based on the Spring Cloud microservice framework. The entire online teaching platform is divided into view layer, gateway layer, business layer and data storage layer. The overall architecture is shown in figure 3.

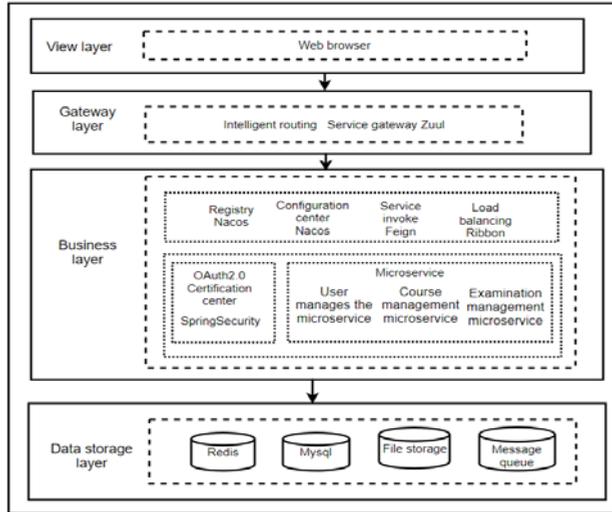


Fig. 3. Overall architecture diagram of the system.

(1)View layer. The user enters the system through the view layer. The view layer is based on the interaction design of Vue and Element UI framework. The Vue framework is used to bind the data in the data storage layer to the front-end page input variables, and the operation of the page and the back-end database is realized synchronously, so that users can have a good page interaction experience.

(2) Gateway layer. The gateway layer is the intermediate layer between the view layer and the business layer. Users enter the front end of the system through the view layer. Before users want to access the back-end database through the front end page, they need to go through the gateway layer first and enter the business layer after passing the test of the gateway layer. The gateway layer contains intelligent routing, service gateway Zuul and other components. Setting the gateway layer can reduce the interaction times between the front-end and back-end architecture layer, and facilitate the realization of logical authentication between the user data and the back-end database when the user carries out corresponding business function operations, thus improving the operation efficiency of the system.

(3) Business layer. The core of the whole system in the business layer includes the Nacos registry, the Nacos configuration center, the service invoke Feign, the load balancing Ribbon, the OAuth2.0 authentication center, Spring Security and the microservice module. The use of the business layer can prevent users from directly interacting with the data storage layer, ensure the security of the back-end database, reduce the complexity of the system, and increase the security of the system. The Nacos registry provides service registration and service discovery functions for each microservice module of the system. Service invoke Feign component can simplify calls between microservices and improve the efficiency of the system. When the system is overloaded, the load balancing Ribbon will take the initiative to share the pressure of the system and relieve the operation function of the system. The combination of OAuth2.0 authentication center and Spring Security technology provides users with identity authentication and authorization functions. Users can conduct corresponding business operations in the system after passing the identity authentication and authorization, and meanwhile enhance the user security of the system.

(4) Data storage layer. The data storage layer encapsulates the information interaction data between the front end and the back end, as well as between the system and external devices. The system stores these data in the Redis cache database, relational database

MySQL, file storage and message queue respectively, so that the data can be quickly found when querying. The user carries out corresponding business function operations through the front-end page, and then the business layer interacts with the data storage layer according to the user's operations to further complete the operation of adding, deleting, querying and modifying the data.

3.3 System security design

Security design is very important in a system. Users should carry out security verification before entering the system. After passing the security verification, they can proceed to the next step. Online teaching platform based on microservice architecture sets security verification as a microservice that can be independently deployed. When users log in to the system, users will call the user authentication and authorization function of security verification microservice, and then determine the user's role and user authority, and carry out corresponding business operations according to the user's role and authority.

In the security design, the system uses the authentication method of combining Spring Security and OAuth2.0. Spring Security is a feature-rich security framework. It is also a framework for identity authentication and authorization tailored for Spring projects. Identity authentication is to verify whether the user belongs to the system and whether the user's personal information exists in the back-end database of the system; authorization refers to the corresponding role permissions of the user in the system, with which the user can carry out corresponding business operations in the system [10]. OAuth2.0 is the most commonly used authorization mechanism at present. Under the premise of abiding by the protocol rules, it allows the third-party platform to obtain certain permissions of the authorized party [11]. If a user wants to log into the system through a third-party platform, the system will first issue a temporary token with a time limit to the user. The temporary token does not contain the user's personal information, such as user name, gender, user password and other private information. Then the third-party platform obtains some permissions of the user through this temporary token, and then carries out relevant business function operations in the system. The OAuth2.0 workflow is shown in figure 4. The combination of Spring Security and OAuth2.0 not only guarantees the security of the users of the online teaching platform based on the microservice architecture, but also improves the authentication efficiency and system availability of the application of the microservice architecture.



Fig. 4. OAuth2.0 workflow.

4 Conclusion

Aiming at the problems existing in the traditional monolithic architecture online teaching platform, this paper proposes an online teaching platform based on microservice

architecture. According to the advantages of microservice low coupling, scalable, easy to expand, high concurrency and easy to maintain, the system is divided into multiple microservice modules that can be independently deployed. These microservice modules realize corresponding functional operations through mutual calls among each microservice, it not only solves the difficulties existing in the traditional online teaching platform, improves the concurrent performance of the system, enhances the expansibility, improves the operating efficiency of the system, reduces the teaching cost, but also provides a new idea and design scheme for the future of the traditional information system.

The authors would like to thank the Fund for the Research on Key Technologies of Intelligent Fault Management Platform for Printing Equipment (Eb202103) for their support in this research.

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