Smart Campus Business Flow Reconstruction Algorithm Based on Unified Identity Authentication and Microservices

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Abstract: Many schools still have manual or semi-automated business processes, which are not only inefficient but also prone to errors. How to use information technology, especially Uniform Identity Authentication (IDS) and microservices, to reconstruct these business flows to achieve the goal of improving efficiency and quality is an urgent one. This paper analyzes a smart campus business flow reconstruction algorithm based on IDS and microservices, introduces the concept of IDS and the theoretical basis of microservices architecture, and clarifies the important role of IDS in smart campus business flow. This paper emphasized the necessity of microservices architecture for business flow reconfiguration, discussed the main steps and methods of identity authentication mechanism reconfiguration and business flow reconfiguration, and pointed out the reconfiguration strategies based on IDS and microservices. Through the experimental test of the smart campus based on IDS and microservices, it was found that through the application of IDS, users could seamlessly switch between systems by logging in once, which greatly improved the user experience and work efficiency. The comprehensive performance score of the system was improved by approximately 10.1%. The smart campus business flow reconstruction algorithm based on IDS and microservices obviously optimized the business process, provides excellent and efficacious campus based solutions, and improves the efficiency of the campus service system as a whole. It has important theoretical significance and practical value for promoting the modern smart campus construction.

Keyword: Smart Campus, Campus Business Flow, Reconstruction Algorithm, Uniform Identity Authentication, Microservices Architecture

1. Introduction

With the development and popularization of information technology, many schools have begun to attempt to build smart campuses to improve education quality, improve the teaching and learning environment, and improve administrative efficiency. In the process of building a smart campus, IDS and microservices are two very important technologies. IDS can solve the problem of user authentication between multiple systems, and microservices can effectively improve the scalability and maintainability

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of the system. However, in practical applications, how to effectively combine IDS and microservices and apply them to the reconstruction of smart campus business flow is an unsolved problem. It is very meaningful to study the smart campus business flow based on IDS and microservices.

As an important part of educational informatization, smart campuses have become an important means of promoting the modernization of school education management. Zhao Yang Dong, based on a comprehensive review of supporting technologies and existing smart campus propositions, constructed a people-oriented, learning oriented smart campus with the main purpose of meeting the interests of stakeholders, improving educational performance and the pace of technological development, and discussing interdisciplinary factors that drive or limit the smart campus revolution [1]. Nagowah Soulakshmee D discussed modeling different collaboration areas in smart campuses, with a focus on smart communities and smart campuses in IoT environments. He introduced a systematic literature review using Google Academic Search [2]. Arini Arini believed that smart campus was a technology that can organize business processes such as ensemble learning, library management and other campus management. Smart campuses could be integrated with smart homes. Smart home devices such as small tools, laptops, and speakers that could be automatically controlled could support academic activities [3]. Longxia Yuan summarized successful cases of current smart cities and smart campuses. The Internet of Things and cloud technology were key additional infrastructure for this application. He analyzed the financial information issues of universities from the perspective of "smart campuses" and evaluated the factors that affected the adoption of intelligent financial information systems on smart university campuses [4]. The application of smart campuses is becoming increasingly widespread. However, many schools often encounter problems in the process of implementing smart campuses, such as inconsistent user authentication methods for various application systems, complex business processes, and low efficiency.

The combination of IDS and microservices can effectively solve the problems of multi system integration and business process reconstruction in smart campus. Rahil Jumiyani focused on the microservices architecture in the smart campus application development case as the smart campus framework architecture, and found that microservices architecture was a method that could be used for application development and could promote continuous evolution activities with the change of business environment, the improvement of performance and system reliability [5]. Ye Weiyu built a smart campus based on microservices architecture technology, discussed the characteristics and advantages of building a smart campus based on microservices architecture technology, and improved the quality of school service, management, teaching and talent training [6]. Based on the research of smart campus environment, Li Xiaoling analyzed the practical experience of "microservices" in the library of University of Sanya and proposed the personalized "microservices" strategy of university library [7]. Zhu Manjing took Jiangxi Open University as an example for construction. Through construction and application, he realized the functions of unified data management, IDS, unified system integration, unified portal and so on, and provided one-stop services of "intelligent teaching, intelligent management and intelligent services" for teachers and students [8]. IDS and microservices can provide a unified identity authentication environment and improve the level of data security

protection of smart campus.

This paper provides an effective methodology and theoretical support for the intelligent college construction and development by researching and implementing IDS and microservices based business process reconfiguration algorithm for intelligent college. By adopting IDS and microservices architecture, the service efficiency and user experience of smart campus can be effectively improved, which is conducive to promoting the construction and development of smart campus.

2. IDS and Microservices of Smart Campus

2.1 Reconstruction of Identity Authentication Mechanism

Due to the diversity of user applications, various mobile computer client applications represented by smart phones have emerged, but the general authentication mechanism has not changed much. The existing smart campus authentication mechanism based on IDS and microservices mainly includes three information interaction processes. The deployment architecture of IDS system is shown in Figure 1.

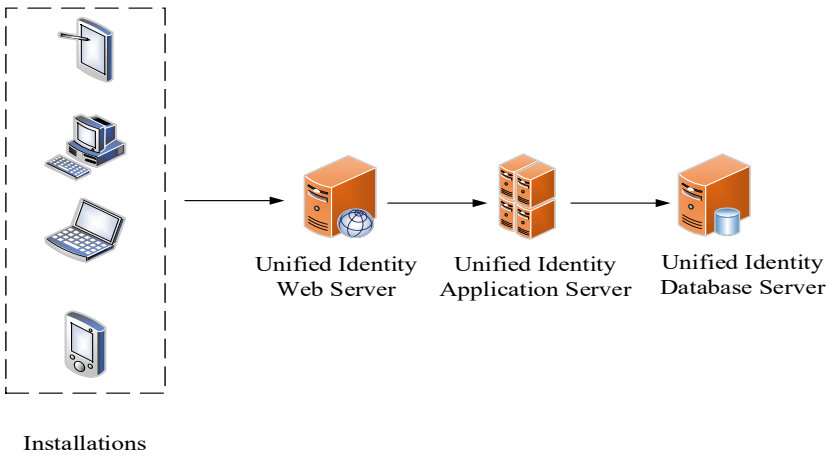

Fig.1 IDS system deployment architecture

2.1.1. Sending Identity Authentication Requests

Before being able to provide universal access to portal embedded application services, customers also need to rely on the unified authentication interface of portal application servers on different terminals such as personal computers and mobile phones to automatically fill in and transmit relevant non human identification data (such as username and password, mobile phone number, and text message verification code) to the network server, in order to submit authentication requests [9-10].

2.1.2. Identity Information Verification and Response

After receiving a request message from the client, the web server immediately forwards the verification message to the application server, and the network server compares the verification data provided by the client with the database server that has saved the relevant verification information to determine whether the client's verification results are correct. The response between the application server and the web client is fed back to the corresponding gateway application server [11-12].

2.1.3. Client Authentication Result Page

The client displays a user authentication result page or prompts an error message on the gateway. The interaction process of the authentication mechanism is not difficult to describe, but users must input and submit the same authentication credentials multiple times in different terminal applications to solve the joint authentication problem of multiple terminal users connected to the gateway application.

2.2 Main Steps and Methods of Business Flow Reconstruction

2.2.1. Business Process Sorting

The existing campus business processes have been comprehensively sorted and analyzed. The sorting process includes collecting information on the functional modules, data interfaces, and business logic of each business subsystem, in order to understand the operation status and business requirements of each subsystem. In addition, it is necessary to identify the dependency relationships between various business subsystems and analyze the role and status of each subsystem in the entire business process.

2.2.2. Business Process Modeling

On the basis of sorting out existing business processes, it is necessary to use business process modeling tools to visually model existing business processes. By modeling, the dependency relationships between various subsystems and the operational logic of business processes can be visually displayed. In addition, the modeling process also helps to identify problems and bottlenecks in existing business processes, providing reference for subsequent optimization.

2.2.3. Requirements Evaluation

After completing business process modeling, it is necessary to conduct in-depth requirement analysis of existing business processes. The analysis process includes identifying pain points and requirements in existing business processes, as well as sorting out potential new requirements in the future. The results of the requirement analysis would provide strong support for subsequent design solutions.

2.2.4. Proposal of Design Plan

Through the analyzed results, a design scheme for the reconstruction of smart campus business flow has been proposed [13-14]. Introducing IDS technology in the solution allows users to access all services with just one login. The microservices architecture is adopted to split the original huge system into independent, small, easy to manage and deploy services, so as to improve the flexibility and maintainability of the system [15-16]. On this basis, it is also necessary to study how to organize and arrange each microservices reasonably to meet the operational requirements of business processes.

2.3 Reconstruction Strategy based on IDS and Microservices

After clarifying the design objectives and steps of the smart campus business flow reconfiguration algorithm, this paper discusses how to use IDS and microservices technology to reconstruct business flow. The specific process is shown in Figure 2.

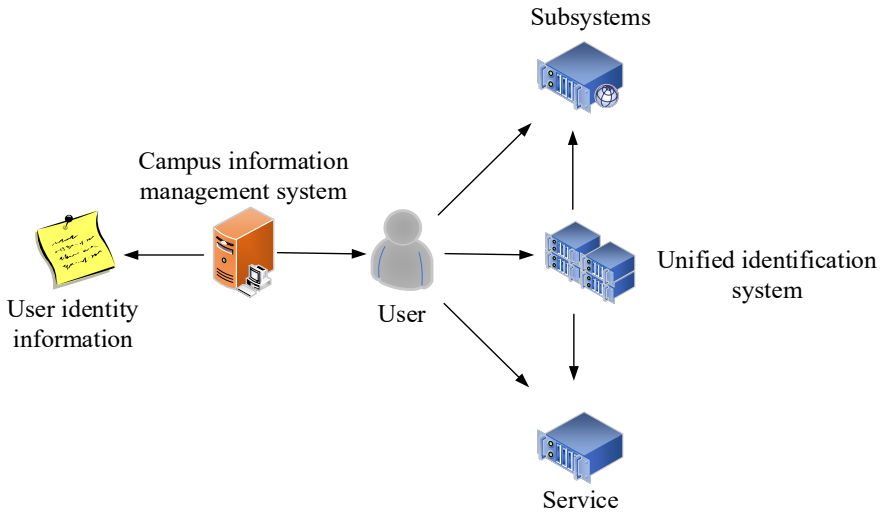

Fig.2 Reconstruction strategy of IDS and microservices

A centralized and unified authentication system is first created as the entry point for all business subsystems and services. After completing login authentication in the unified authentication system, users can freely switch between different subsystems and services without the need to log in again [17-18]. To achieve this goal, the current mainstream unified authentication technology can be adopted, combined with the existing information management system of the school, to integrate and manage user identity information [19-20]. Initially, a large and complex system would be decomposed into a series of independent, small, easy to manage and deploy microservices. More specifically, the initial system can be decomposed into a series of relatively independent modular microservices according to business functions and data boundaries. In order to ensure effective invocation and cooperation between microservices, it is also necessary to consider how to organize and coordinate services and how to control services. By implementing a unified authentication and microservices architecture, existing business processes should also be optimized. Especially, it is possible to extract and model business processes, identify pain points and bottlenecks in existing processes, and then optimize and improve business processes by adjusting dependencies between services and optimizing business logic.

3. Smart Campus Experiment Test Based on IDS and Microservices

In order to verify the effectiveness of the smart campus business flow reconstruction algorithm based on IDS and microservices, this paper designs an experiment, which would be carried out in the student educational administration management system of a university. The main objectives of the experiment design are two points: The first is to verify the application effect of IDS in the smart campus, and achieve seamless switching between users in various systems; the second is to verify whether the microservices architecture can enhance the flexibility and maintainability of the platform and optimize the business processes.

3.1 Application Effect of IDS in Smart Campus

The IDS system integrates all business systems, including the academic affairs system, graduation design system, library system, etc., and establishes a unified user login verification process. It selected typical users (such as students, teachers, and academic staff) and simulated their use of smart campus systems in daily work and learning scenarios. For example, students need to query grades, select courses, view notifications, etc; Teachers need to upload course materials, enter grades, etc; Academic staff need to manage student information, arrange courses, etc. The test results are shown in Table 1.

TABLE I. TEST RESULTS OF THE APPLICATION EFFECT OF IDS IN SMART CAMPUSES

	Number of logins	Number of system switching times	Number of login attempts
Student	1	5	0
Teacher	1	5	0
Academic staff	1	4	0

From Table 1, it can be seen that by applying IDS, users only need to log in once to seamlessly switch between various systems, greatly improving the user experience and work efficiency.

3.2 System Flexibility and Maintainability Testing

On the basis of the microservices architecture, the original single application is split into multiple independent services. The differences in flexibility and maintainability between new and old systems are compared. Five users were randomly selected to rate the flexibility and maintainability of traditional and improved systems, as shown in Figure 3.

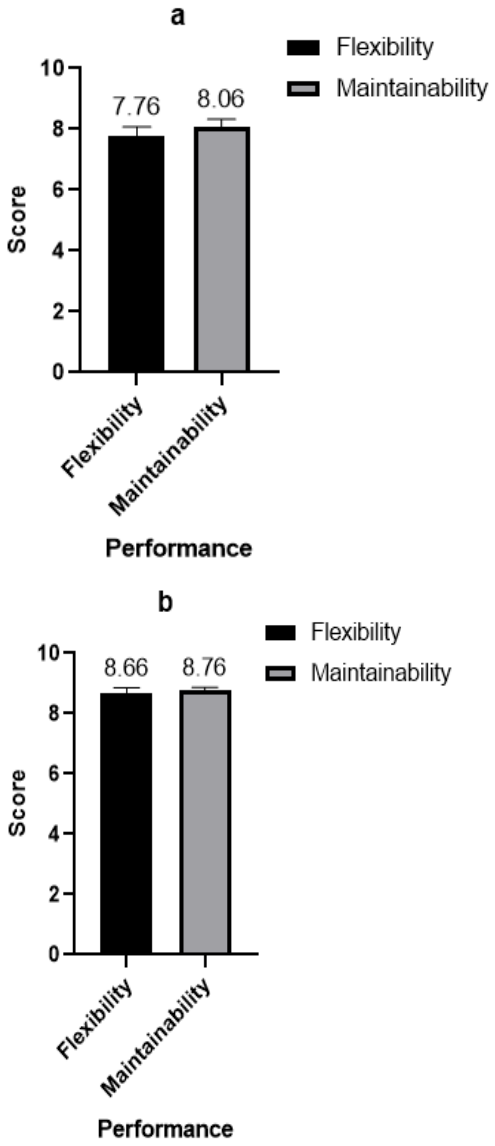

Figure a. Traditional system performance rating
Figure b. Improved system performance rating

Fig.3 System flexibility and maintainability test results

From Figure 3, it can be seen that Figure a shows the performance evaluation results of the traditional system, while Figure b shows the performance evaluation results of the improved system. The average flexibility score of traditional systems is 7.76 points, and the average maintainability score is 8.06 points. The average comprehensive performance score is 7.91 points. The average score for improving the

flexibility of the system is 8.66 points, and the average score for maintainability is 8.76 points. The average comprehensive performance score is 8.71 points. The overall performance score has increased by approximately 10.1%.

4. Conclusions

This paper focuses on IDS and microservices based business process re-engineering algorithms for smart campuses. By designing effective smart campus business process reconstruction, this paper optimized the current campus service delivery mode, effectively improved the efficiency and quality of the campus service system, and improved the user experience. Under the framework of IDS and microservices, a novel reconfiguration algorithm of smart campus business flow was developed. This algorithm provided users with more precise and personalized services based on a deep understanding and analysis of their needs, which was conducive to optimizing the user interface, improving operational efficiency, and achieving personalized services and resource optimization allocation in smart campuses.

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