Construction of Construction Technology Simulation Teaching System Based on SOA

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Abstract. Building construction virtual simulation teaching is based on the construction industry standards and the relevant syllabus promulgated by the Ministry of Education of the People's Republic of China. Creating an artificial virtual environment with visual, auditory and tactile senses, that is, the simulation teaching system of civil engineering construction technology, and forming an integrated course teaching system of theory and practice, which integrates teaching, learning, practice and examination, can alleviate many problems such as the construction site is difficult, dangerous, affected by the construction period, the training base has much investment and consumption, etc., and make students' practice get twice the result with half the effort. The problem of "information island" exists in the informatization construction of colleges and universities. SOA with service-oriented architecture, as a new generation architecture, is one of the most ideal solutions for heterogeneous system integration and application system integration. It can not only meet the needs of personnel training, but also solve the problem of insufficient allocation of experimental teaching resources to a certain extent. It has certain progressiveness, pertinence and applicability for improving the training quality of civil engineering professionals. This paper expounds the basic idea of integrating remote experimental resources and related software technology, and puts forward the three-tier technical architecture, system function architecture and network topology of the remote experimental teaching system based on SOA, which breaks through the common key technologies in the construction of remote open experimental teaching environment.

Keywords: Simulation teaching system · Service-oriented architecture · Construction technology

1 Introduction

The teaching reform aimed at the working process of various architecture schools has changed from the simulation component curriculum system and curriculum arrangement to the teaching implementation stage. The carrier of curriculum implementation, teaching design and implementation have become the biggest problem, and whether the teaching curriculum reform can be fully implemented. And important factors of the new curriculum standard [1]. How to change the traditional management mode, build an efficient management system, improve the management level and quality, so that the

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teaching management in colleges and universities can be scientific and modern, and adapt to the rapid development of higher education, has become the urgent task of teaching management reform in higher education [2]. Adopting the idea of SOA architecture to develop a new teaching management system can solve the above problems without changing the underlying architecture of various applications, and this architecture can better meet the needs of business development [3].

Virtual reality (VR) is a high and new technology developed in recent ten years [4]. It is characterized by artificially generating a virtual environment in the computer. Through the three-dimensional digital graphic model formed by the computer and programmed by the software, a perceptible comprehensive artificial environment dominated by visual perception, including touch and hearing, can communicate and interact with it, make people "integrate" harmoniously with virtual reality and give people an immersive feeling [5]. The application of computer technology to the teaching management system of colleges and universities has become the most natural and effective way of thinking for the reform of teaching management in colleges and universities. Advantages that are not available. The biggest purpose of SOA architecture is to reuse the services in existing applications as much as possible to improve the practicability and adaptability of the system [6]. The construction of teaching management system based on SOA is of great significance: it can greatly reduce the workload of teaching management, ensure the institutionalization of teaching management, make teaching management really bid farewell to the traditional manual or semi-manual mode, and improve the service level of teaching management; It can provide fast and reliable decision-making help for the construction and development of schools [7].

2 SOA-Based Simulation Teaching System of Architectural Engineering Construction Technology

2.1 Construction of Virtual Simulation Teaching System of Construction Technology

Installation works include building water supply and drainage works, ventilation and air conditioning works, building fire protection works, building heating works, building electrical works, building intelligent works, building security system, building lightning protection and grounding works and other main systems. Firstly, the platform needs to design the content, breadth and depth of special skills training to meet the comprehensive theoretical knowledge, and pay attention to the relationship between professional theoretical knowledge and professional ability Reconstruction and decomposition [8]. Keeping pace with the times, integrating new structures, new technologies, new materials, and new processes that have appeared in engineering in recent years with the training simulation platform, and studying the ways and methods to stimulate students' innovative ability in the process of training [9]. Study the intersection and integration of different modules and different levels, and completely reproduce the installation construction technology and management process with the help of training simulation platform. The simulation system of construction technology consists of seven simulation systems, as shown in Fig. 1.

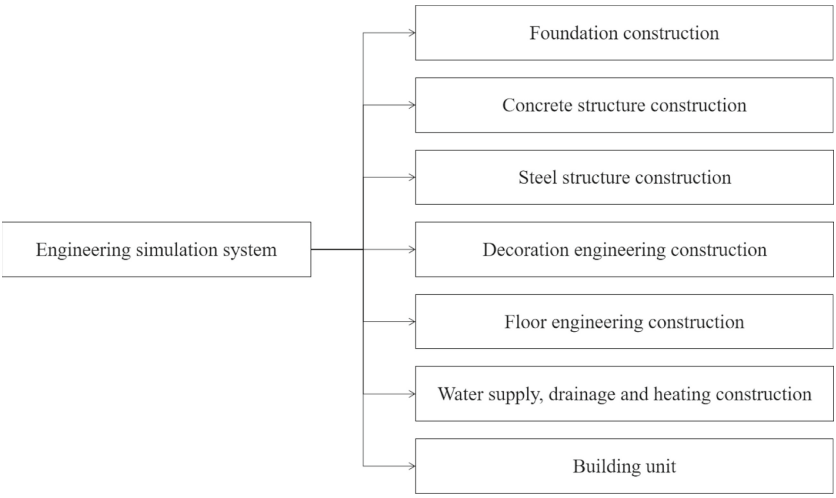

Fig. 1. Composition of simulation system for construction technology of building engineering

The system has three identities: student user, teacher user and administrator user. They have different functions and permissions. The administrator can change the login password of teachers; Teachers can arbitrarily choose the training content, which can be used as a teacher's classroom demonstration. The training content does not accumulate scores. At the same time, teachers and users can change the test questions in the background and query the students' training results [10].

In the teaching form, a large number of man-machine dialogues are used to complete various tasks. Through dialogue with virtual "squad leader", "chief engineer" and other personnel with different positions, types of work, and positions, and can interact through "question-answer". With the help of artificial intelligence technology, real feedback and analysis of the learner's operation are carried out to provide solutions to the problems that arise. Simulation training teaching system is a teaching simulation software for various special skill training. Different from the general courseware, it is developed based on three-dimensional visual control technology. It has higher requirements than the general teaching software [11]. It has the characteristics of vivid, strong operability, high efficiency and safety. Therefore, it can make the teaching and training effect better, closer to the actual training and beyond the actual training. The materialization of each system of the installation project can replace the understanding of the contents of the practice installation part, which not only saves the cost of teaching for the school, but also helps to cultivate students' professional quality and accumulate engineering experience, without any safety problems. Simulation is a teaching activity carried out in a virtual environment with good openness, wide-area, real-time and interactivity. Learners are not limited by the time and space of the construction site, and are not limited by the dangerous safety problems of the construction site. It can be accepted by learners in a flexible and convenient way. Teachers' careful design of skills simulation training teaching platform is helpful to cultivate students' professional ability, practical ability and innovative ability [12].

2.2 Design of Teaching Management System Architecture Based on SOA

Using the teaching management system based on SOA architecture, the relatively independent business functions involved in the original teaching management can be encapsulated into Web services. In order to reduce the construction and operation management costs of the experimental system and improve the usability and stability, issues such as data standards, service encapsulation and registration, user management and authentication and authorization mechanisms, monitoring mechanisms, technical planning, and operation and maintenance processes need to be considered. SOA does not define specific technologies and methods to implement services. At present, WebService is considered to be the most suitable technical standard to realize service-oriented architecture [13]. The core technologies of real WebService are XML, soap, WSDL and UDDI. The representation of XM (Extensible Markup Language) is extremely simple, and any application can easily read and write the data in it. Wsdl (Web service description language) is used to describe the communication between Web services, and it is the norm and standard of web service transaction, service composition and service security. The system consists of service support layer, general service layer and service application layer. Each layer has clear logic and clear functions, and emphasizes standardization, reusability and robustness. The model architecture of the distance experimental teaching system is shown in Fig. 2.

The service support layer integrates the basic information and interface information of the database storage software, and is composed of the experimental management platform, experimental data, integrated software data and experimental resource data. It is located on the database server side and is responsible for processing registration and cancellation requests from service providers. The service of the service registration center matches and maps with the registered services, and performs service-based encapsulation, service-based adaptation and message brokering for various heterogeneous experimental resources, so as to provide the required service-based service for the creation of

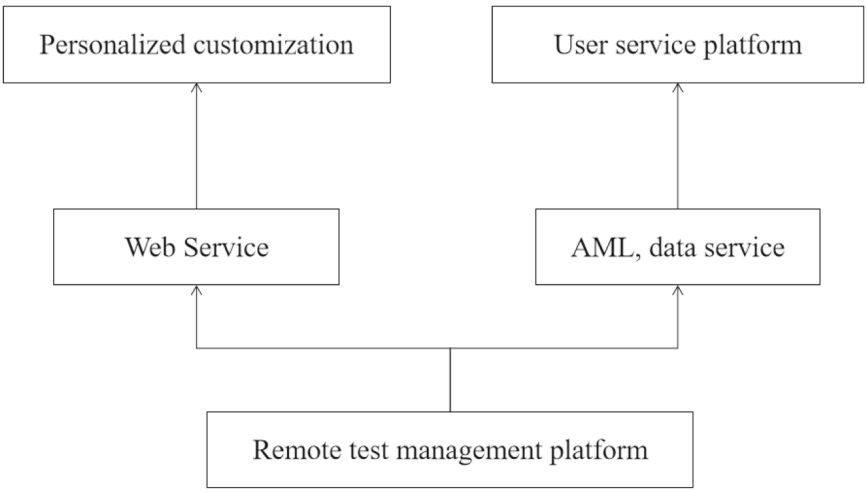

Fig. 2. System model architecture

remote experimental teaching projects. Resources to provide underlying support for the system. It sends a request to the service support layer, establishes the actual database connection, generates SQL statements to retrieve or update the database according to the user request submitted by the service application layer, and returns the data processing results to the service application layer, which is responsible for displaying them to users. The operation and operation of the experimental project are realized through the services provided by the general service layer, and the communication between users and the general service layer is realized through browser or client software. This layer can effectively support the reconstruction and resource reuse of experimental software. In the service application layer, each experimental project is a web page unit developed based on standard HTML form, which is responsible for receiving the input data required by the experiment and displaying the experimental results.

3 Limitations and Countermeasures of Virtual Construction Teaching and Training

3.1 Student Management Module Design

Student management module involves three types of roles: academic staff, students and system administrators. Academic staff input, edit and maintain student information; Then students can query their own related information through the student management module; System administrators are responsible for the maintenance of system operation and data security. The use cases of the student management subsystem are analyzed below. Use case diagram describes the relationship between participants and use cases, which is an externally visible description of system functions. Use case diagram can not only express the relationship between participants and the system, but also the relationship between use cases. Use cases are designed to statically describe the system and help complete the functional division of the system. User business logic needs to be described by dynamic models. The following highlights the enrolment activities involved in the Student Management module. Figure 3 shows the timing chart of freshmen enrollment.

The enrollment management module mainly divides classes according to the freshmen's college entrance examination scores. First of all, the academic staff use the entrance score entry module to enter the entrance score of the college entrance examination, and then enter the class management module to divide the class. Classes can be divided by the system according to the preset standards, mainly considering the fairness of students' grades in each class. Assuming that the length of the rectangular space to be laid out is l and the height is h, take the lower left corner of the rectangular space as the coordinate origin, record it as (0, 0), and the coordinates of the upper right corner are (L, w). The length of a standard rectangular block is L and the height is H.. Each standard small rectangular block can be cut, that is, the length of the standard small rectangular block can be changed according to the situation during layout, but the height of the standard small rectangular block cannot be changed. If there are n standard small rectangular blocks, the length of the ith small rectangular block after being arranged in the wall is I, ($0 < i < n$), and the height is H. (xu, yu) and (xu, yu) represent the lower left corner and upper right corner coordinates of the ith brick after being arranged in the

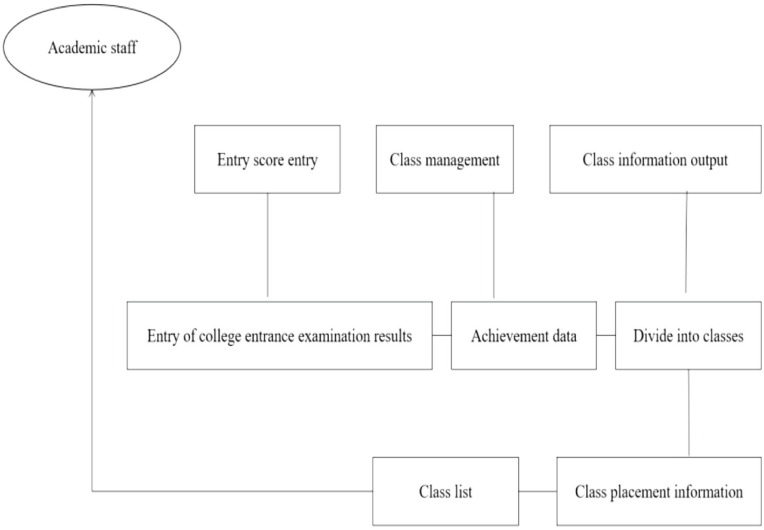

Fig. 3. Freshman Admission Sequence

wall. The mathematical model of SOA mentioned in this paper is as follows:

$$\max\ s = \sum_{i-1}^{n} q_i l_i h \tag{1}$$

Subject to:

$$q_i 1 = (x_{ir} - x_{i1} = l_i) \wedge (y_{ir} - y_{il} = h) \tag{2}$$

$$q_{i2} = (0 \leq x_{il} \leq x_{ir} \leq L) \wedge (0 \leq y_{il} \leq y_{ir} \leq w) \tag{3}$$

In the above formula, i, j = 1,2…, n, and i ≠ j. Formula 2 indicates that the small rectangular block needs to be placed horizontally in the space to be distributed and cannot be tilted. If it meets the requirements, then qi1 = 0, otherwise 01 = iq. Formula 3 indicates that the small rectangular block after the layout must be within the space to be distributed and cannot be out of bounds. If it meets the requirements, then qi2 = 1, otherwise qi2 = 0. Formula 1 indicates that the two small rectangular blocks cannot have overlapping parts. If they meet the requirements, qi3 = 1, otherwise qi3 = 0.

3.2 An Effective Way to Improve the Effect of Simulation Teaching

Since teaching management is a complex business process, we only encapsulate the common subsystems in the teaching management system (such as teaching resource management system, teaching plan management system, student information management system, timetable management system, etc.) to illustrate the system integration method based on SOA architecture. Table 1 shows the integration framework of teaching management collaboration system based on SOA.

Table 1. Integration framework of teaching management cooperation system.

Field name	Type	Length	Attributes	Meaning
Course Name	Varchar	16	Not Null	Course Title
Course Serial Num	Varchar	20	Null	Course serial number
Course Rank	Varchar	30	Null	Course level
Course Point	Varchar	15	Null	Credit
Classroom	Varchar	10	Null	Class classroom
Experiment	Varchar	25	Null	Experimental arrangement
Mem	Varchar	130	Null	Remark

Although virtual reality technology can simulate the three-dimensional construction process on site, students still cannot experience the real production process, and it is difficult to establish a perceptual understanding of actual engineering. Since students usually use the system for study and training, the introduction of assessment on this basis can help students to play the assessment. The test questions are mainly based on the key knowledge points based on the actual acceptance standards of the project to strengthen the proficiency of core technologies. Improve the professional quality of students. Through multimedia display, use the mouse, keyboard and even simulate the operation of parts to operate the virtual simulation object at the other end of the screen freely, so as to realize the training before entering the construction site. Through this function, students can choose any training course, deeply understand the operation process and deepen their memory, which can improve students' skill level. The idea of SOA architecture is used to integrate the teaching management system, and the functional modules that need to be shared in the original teaching management system are encapsulated into Web services. The functions of SOA architecture can be realized by creating, testing, publishing and calling Web services. From the specific performance point of view, users can make performance statistics according to conditions. For example, the user selects the name of the major, then selects the specified course of the specified class in the major, then selects the statistical grade distribution, and then selects the histogram as the expression form. The system gives the grade distribution of the selected course in the class in the form of histogram, intuitively showing the number of students in each grade segment, as shown in Fig. 4.

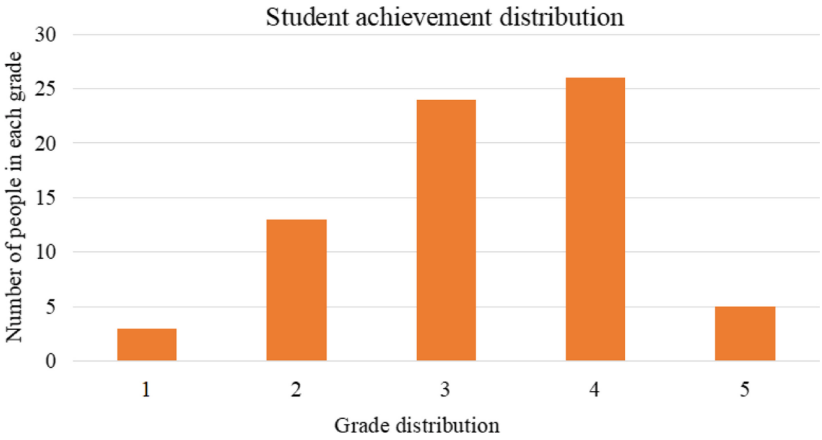

Fig. 4. Schematic diagram of the distribution of grades

4 Conclusion

Although the virtual simulation of building construction realizes the high restoration of the physical object, there are still some defects in the simulation training. According to different levels of students, set different levels of examination questions to stimulate interest in learning professional knowledge, improve learning enthusiasm and teaching effect, and maximize the ability to cultivate professional talents for the country. The simulation teaching system of engineering construction technology has built a teaching platform that combines theoretical study with production practice for architectural majors in higher vocational colleges. It has made up for the limitations of teaching means, training conditions, time and space, and realized the consistency between teaching projects and construction projects, teaching process and construction process, school study and actual work in the classroom. Aiming at the problem that theoretical knowledge and engineering practice are out of touch in the teaching process of installation engineering construction course, this paper puts forward a construction method of installation engineering simulation training platform. Focus on building the spatial connection of each part of each system. On this basis, students can make the solid model and simulate the complete construction process of each system in the installation project. It really realizes the reorganization of information resources at the lowest cost to cope with the changing business processes without changing the original basic resources. In this paper, the architecture idea of SOA is successfully integrated with Web Service technology, and the architecture design and implementation of teaching management system based on SOA are realized, which proves the feasibility of integrating the resources of the original teaching management system with SOA architecture idea.

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