



Research on intelligent learning platform system based on Spring Boot

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Abstract. With the popularity of the Internet, people's way to explore knowledge began to go to the Internet, digital intelligent learning platform emerged at the historic moment. As for the traditional teaching method, it is taught at a fixed time and place, and the form of education and learning is not free enough. Compared with traditional teaching methods, students can freely access more diverse teaching resources through intelligent learning platform, and they can repeatedly learn the required course knowledge according to actual needs. At the same time, they can also ask questions and communicate on intelligent learning platform. This paper mainly studies the design and implementation of intelligent learning platform based on Spring Boot. The main function of this platform is to seek a convenient means of intelligent teaching and management for teachers and students, so that students can easily study independently and watch the teaching videos uploaded by teachers. Obviously, intelligent learning platform can improve students' enthusiasm for self-study. Technically, the platform uses the front-end and back-end separation architecture to deploy, develop and debug the front-end and back-end projects separately. The front end selects the progressive framework vue.js to complete the complex interaction logic and two-way binding of the front end, and selects ElementUI to design simple pages. Back end selection of Spring Boot, as the overall framework of intelligent learning platform backend, with Java to achieve interface function design, Redis in the Laragon environment to achieve cache optimization, MyBatis to achieve persistent layer development, and MySQL to achieve data storage. This platform provides an intelligent learning and management solution for teachers and students, and is committed to improving the efficiency of learning. After testing, the intelligent learning platform achieved in this paper meets the expected results and achieves good performance.

Keywords: Spring Boot; Intelligent learning platform; Separated architecture; Redis cache optimization

1 Introduction

At present, the digital economy is more and more strong, all walks of life are connected to the Internet, and the education industry is also connected to the Internet. As a result, the way people acquire knowledge has changed significantly. Due to the limitations of traditional teaching forms, people begin to get used to learning from the Internet, and the new learning concept has been deeply rooted in the hearts of people. Before the Internet era, there existed the problem of low efficiency of classroom teaching due to technical limitations. When students participate in offline classroom learning, distraction or lack of relevant knowledge reserve will lead to low learning efficiency. However, due to the limitation of teaching time, teachers cannot always guide students to review and tidy up. Online learning platform undertakes the task of supporting and serving online learning.^[1]

The online learning platform supports teachers to upload corresponding teaching videos, so that students can receive education online. Its intelligent service can help students review the content they need in their spare time, prepare the new content actively, and communicate with the confused content. For students, the problem of keeping up with the teaching progress in offline classroom teaching can be solved. The mutual cooperation and complement of offline and online learning can achieve better learning results. From the perspective of users, it can improve students' initiative and autonomy in learning, break the restrictions on learning time and learning place, and make the learning environment more liberal.^[2] Online learning is now a necessity, a common and important part of students' quest for knowledge. It is clear that online learning platforms have never been more popular, and their prospects will be considerable. Obviously, there are many advantages to acquiring knowledge from the Internet. The study of intelligent learning platform in this paper has application value and practical significance, and can promote the improvement and sustainable development of intelligent learning platform.

2 Analysis of key technologies

2.1 Spring Boot

Spring Boot is a sub project of Spring. In today's popular development mode of front and back end separation, Spring Boot can be used to quickly develop background, and the automatic configuration it provides greatly improves the development efficiency of background.^[3] Spring Boot has changed the bloated projects of the past, with heavy configuration becoming a thing of the past, replaced by automated configuration. Spring Boot uses the spring-boot-starter to automatically configure the dependency modules used by users. Developers can use basic project automation tools such as Maven or Gradle to automatically add relevant modules to Spring Boot, such as Web modules and data access modules. This eliminates the need for developers to focus on configuration, which increases focus.

2.2 Vue.js

Vue.js is an incremental framework. Vue.js focuses on the view layer and works with useful component libraries such as ElementUI for interactive logic and page design. Component is an important feature of vue.js. The Vue component system implements extended HTML elements that encapsulate usable code.^[4] Compared with React. Js, vue.js is different in that vue.js essentially adopts MVVM mode, encourages the use of HTML template rendering, and features bi-directional data binding. React. Js uses the MVC pattern, which encourages JavaScript syntax and one-way data flow.

2.3 Reed cache technology

Redis is NoSQL (non-relational database). Redis supports a variety of data structures, has the advantages of high scalability of NoSQL, at the same time in high concurrency scenarios show extremely high performance and easy configuration, deployment advantages.^[5] The key of Redis can only be strings, and atomic operation can be performed by keys. All data of Redis runs in memory and can be configured to persist on disk. Therefore, Redis is fast in reading and writing. In addition, Redis supports high availability and clustering, as well as publish-subscribe queues, Lua scripting, expiration, locking, transactions, and more. All in all, Redis not only has a variety of easy-to-use features, but also a wealth of data types, and excellent performance.

2.4 Back-end separation architecture

Separation of front and back ends: User interface and business logic can be divided into different sub-modules for independent construction and operation.^[6] Front-end and back-end separation is related to project management, which is a feasible project management scheme, and its opposite is front-end and back-end coupling.

As the demand of software products increases, the front-end needs to present more and more complicated things, and the back-end is also more and more complex, which makes the template engine technology such as JSP, Thymeleaf is unable to achieve efficient development. Therefore, a set of engineering and modular architecture is needed to solve the development inefficiency caused by the coupling of the front and back ends, so as to change the status quo that the back-end developers actually undertake the front-end work.

After the front and back end are separated, the front and back end projects interact with interfaces, such as using RESTFUL Swagger API interface documentation, and with Mock servers that provide "fake data." This way, front and back end developers can deploy and develop independently of each other without waiting for each other's progress, as long as they agree on model-level interface specifications, such as request methods and data formats, and finally test after development. Obviously, the advantages of front-end and back-end separation are project decoupling and responsibility separation, which reduces the difficulty of development and maintenance, thus improving the efficiency of work.

3 Design of intelligent learning platform system

The intelligent learning platform system of Spring Boot aims to provide intelligent teaching and management for teachers and students, provide intuitive and convenient user experience, and meet the needs of students to watch learning videos and teachers and administrators to manage learning videos. The five demand modules involved in this platform are user information module, course video module, user interaction module, data analysis module and notification management module. Whether the website is convenient to use, whether the video playback is smooth, whether the system is safe and personalized will affect the experience of learners. [7]

3.1 System functional structure diagram

The functional structure of the intelligent learning platform is shown in Figure 1. According to the demand analysis, the system of the platform is divided into five functional modules, namely, user interaction module, course video module, user information module, data analysis module and notification management module. The users of intelligent learning platform are divided into three identities: students, teachers and administrators [8]. The difference lies in the functions and services they have. Students cannot access the functions of management and data analysis in the module, teachers can access part of the management functions in the module, such as management of their uploaded teaching videos, and administrators can access all modules, including all functions of browsing, management and data analysis.

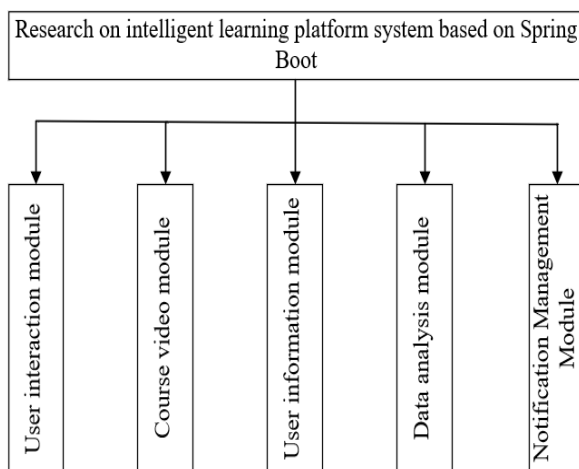


Fig. 1. System functional structure diagram

3.2 Main functional modules

(1) User information module.

As shown in Figure 2 below: The user information module of intelligent learning platform mainly includes basic functions such as login and registration and user information management. After a user logs in to the intelligent learning platform, the server needs to identify the user. If the user is an administrator, the user has all permissions on the intelligent learning platform, including querying and managing user information. If other users have specific permissions, they cannot access the user information management page of the intelligent learning platform.

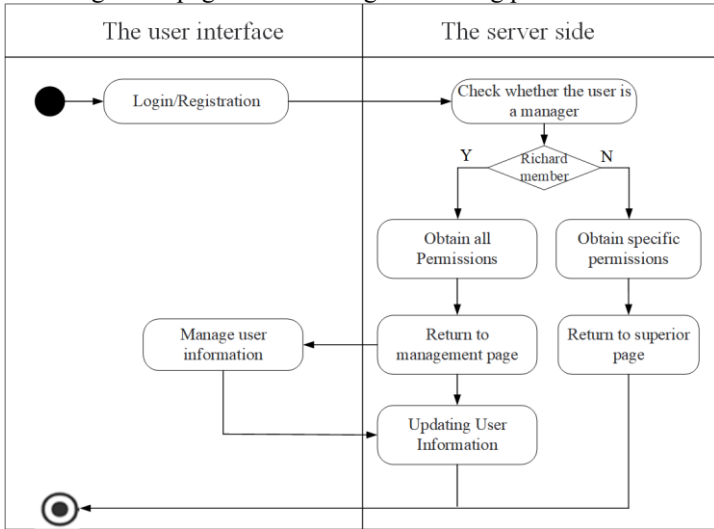


Fig. 2. Activity diagram of user information module

(2) Course video module.

In the course video module of intelligent learning platform, the administrator user can manage the course video, and all users can build a query object according to different screening conditions, and the server will return the query result. Users can click the course they are interested in according to the query result, and then watch the video in the course [9]. When users select a course, they can know the main information of the course, such as course catalog, playback data and course overview. Enter the selected course video page, and there should be comments and questions at the bottom of the video, so that students with common learning interests can answer and communicate with each other and share their knowledge.

(3) User interaction module.

When users of intelligent learning platforms watch specific videos, they write them into their history. Users can like, favorite, comment and other interactive functions, and can view the corresponding records. Users can also complete the exercises, and the server will perform the matching operation and return the results of the answers [10]. Therefore, in order to meet the personalized learning needs, it is necessary to provide intelligent course retrieval functions for learners. Users can conduct fuzzy search according to course keywords, conduct classified search according to subject

category and course category, and conduct sorting search according to release time, broadcast volume and popularity value.

(4) Data analysis module.

As shown in Figure 3 below: The administrator of intelligent learning platform can perform data statistical analysis and obtain data statistics information from the server, while the non-administrator has no access. Administrators can access the statistics of students' participation, the statistics of course broadcast data and the statistics of course satisfaction, which can reflect the overall popularity of intelligent learning platform. For the administrators of the platform, they need to check the data statistics and feedback information of the intelligent learning platform, which can reflect the degree of course satisfaction. At the same time, they also need to upload and manage various types of courses. When releasing new courses, they need to inform the corresponding students to watch them.

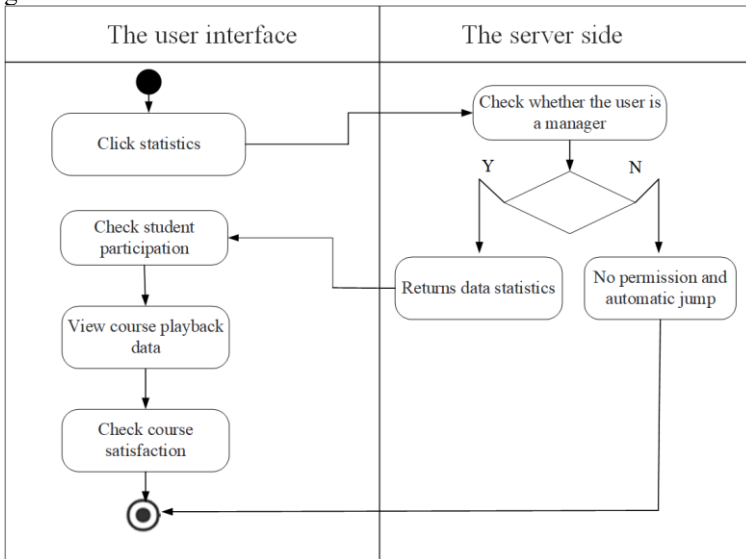


Fig. 3. Flow design diagram of data analysis module

4 Research on hierarchical design of system architecture

4.1 Hierarchical design of system architecture

The hierarchical design diagram of the system architecture of the intelligent learning platform based on Spring Boot is shown in Figure 4:

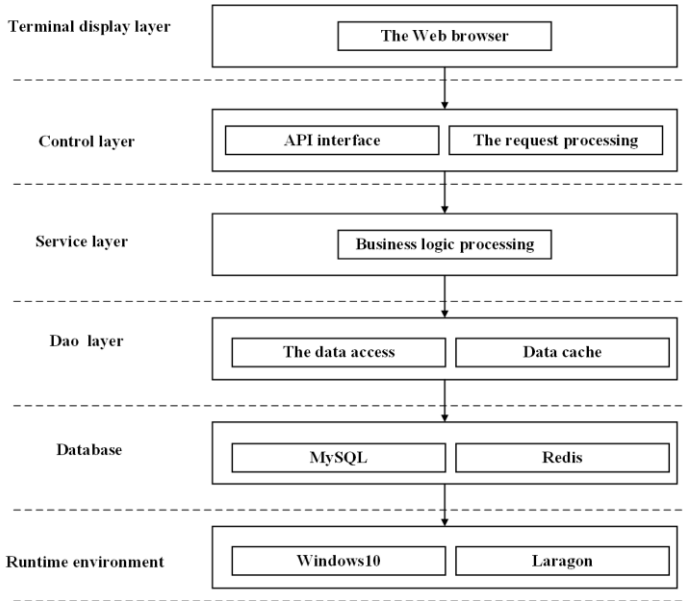


Fig. 4. Hierarchical design of system architecture

(1) Terminal display layer: namely, the front-end page of intelligent learning platform accessed by users through Web browsers. Vue.js is responsible for completing complex front-end interaction logic, and ElementUI is responsible for completing simple front-end page design. The front end is supported by vuE-AXIos plug-in to provide asynchronous request. The front end sends asynchronous request to the corresponding API interface of the back end with the help of the plug-in, and can start other operations without waiting for the response^[11]. After the response arrives and the notification is called back, the next business processing can be carried out.

(2) Control layer: The control layer, which provides API interface and displays Swagger API interface documents to the front end, is mainly responsible for receiving HTTP and other types of requests sent from the front end and providing basic parameter verification. Then the parameters are handed over to the Service layer to complete the business processing of the intelligent learning platform. The returned results after business processing are returned to the front-end in JSON format to render the page of the intelligent learning platform.

(3) Service layer: namely business logic layer, it needs database data or cache data from Dao layer, so as to provide Service for business logic processing of intelligent learning platform.

(4) Dao layer: data access layer, which is supported by object-relational mapping provided by MyBatis, interacts directly with the underlying database of intelligent learning platform, such as adding, deleting, modifying and checking records from MySQL, and adding, deleting, modifying and checking key values from Redis.

(5) Database: Basic data is stored in MySQL. In addition, cached data is stored in Redis.

(6) Operating environment: the project runs in Windows10 system. In addition, Redis runs on the Laragon integrated development environment.

4.2 Development environment of the system

The system development environment of intelligent learning platform is shown in Table 1. In the development process, Spring Boot was used in IntelliJ IDEA and MyBatis to develop the back-end part of intelligent learning platform, and vue.js was used in Visual Studio Code to develop the front-end part with ElementUI. Use Navicat Premium visualization platform to operate MySQL and run Redis on Laragon platform.

Table 1. Development environment of the system

The name of the configuration	parameter
The operating system	Windows10
The browser	Chrome
The Web container	Tomcat9
Development platform	IntelliJ IDEA; Navicat Premium; Visual Studio Code; Laragon
The database	MySQL; Redis
Development framework	Spring Boot; Mybatis; Vue.js; ElementUI

4.3 Data analysis module

The administrator of the intelligent learning platform can view the statistics of playing data of each discipline in the background management page. The statistics of playing data are displayed in the form of a bar chart. The playing data includes the total playing quantity of courses, the total number of likes and the total number of favorites, so that the administrator can easily see the popularity of each discipline.

The administrator of the intelligent learning platform can view the statistics of the popularity of each course in the background management page. The popularity of the course is reflected by the popularity value, the number of plays, the number of likes and the number of favorites^[12]. The administrator can also sort the courses according to the four data, so as to highlight the popularity of the courses. Intelligent learning platform administrator can view in the background management page to each student's participation, the students' participation is a platform used by students in browsing and real-time recording, through statistic the number of students to watch video, participate in discussions and, more recently, the number of online time, can reflect the students' activity, also can reflect the popular situation of platform.

Statistics of students in the past three years						
						2021.09
Year	Enrollment number	The number of graduates	Number of students	The loss of the number	Wastage rate (%)	Annual loss rate (%)
2019	1584	1207	1207	377	23.80	7.93
2020	1216	860	928	288	23.68	7.89
2021	1586	865	910	474	34.25	17.12

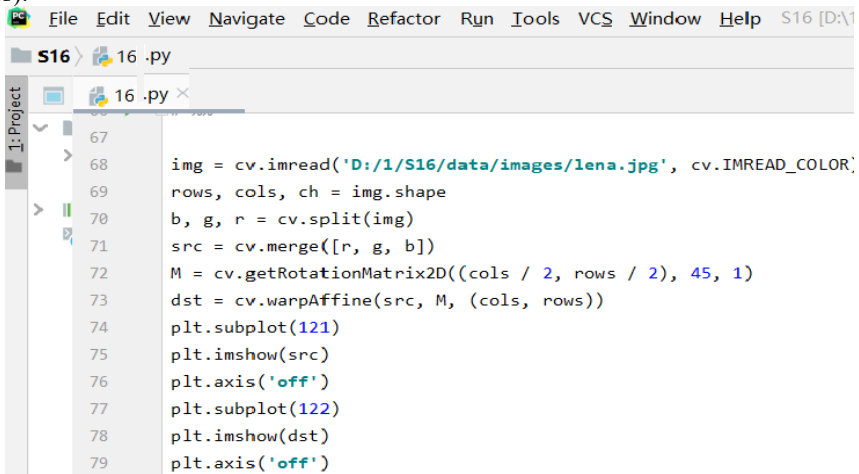
Fig. 5. Data analysis module - Student participation page

5 Intelligent platform system test

5.1 System interface test

Swagger is a standardized and complete framework that provides a RESTFUL interface for automatic online document generation and testing. [8] The so-called RESTFUL interface is actually a set of interface design style, which standardizes THE HTTP verb, URI format, convenient interface management and testing.

As shown in Figure 6, The front-end page of Swagger sends a restful request with HTTP verb as get to the back-end interface of the intelligent learning platform, and obtains the response result in JSON format, whose response status code is 200 (success).



```

File Edit View Navigate Code Refactor Run Tools VCS Window Help S16 [D:\
S16 \ 16 .py
1:Project
67
68 img = cv.imread('D:/S16/data/images/lena.jpg', cv.IMREAD_COLOR)
69 rows, cols, ch = img.shape
70 b, g, r = cv.split(img)
71 src = cv.merge([r, g, b])
72 M = cv.getRotationMatrix2D((cols / 2, rows / 2), 45, 1)
73 dst = cv.warpAffine(src, M, (cols, rows))
74 plt.subplot(121)
75 plt.imshow(src)
76 plt.axis('off')
77 plt.subplot(122)
78 plt.imshow(dst)
79 plt.axis('off')

```

Fig. 6. Example diagram of Swagger sending requests for the platform

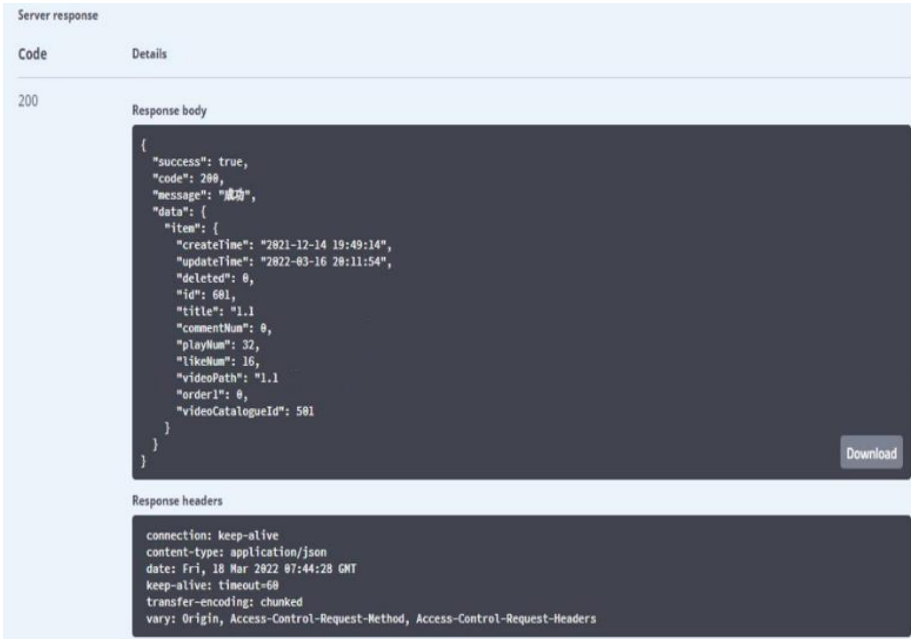


Fig. 7. Sample diagram of Swagger response results

5.2 User information module interface test

The course video module of intelligent learning platform corresponds to the Java class Video Controller in the back-end control layer. The main interface involves the function of adding, deleting, modifying and checking course information, course chapter information and video content, as well as uploading files. The main interfaces of the user information module of the intelligent learning platform all passed the test successfully, and the response status codes were all 200 (success).

Table 2. User information module - main interface test results

The test content	Request path	Parameters to describe	The expected results	The test results
Get user list	POST:/user/{page}/{limit}	Number of records per page; Current page number; User Query Object	200 (Success)	200 (Success)
The user login	POST:/user/login	The user object	200 (Success)	200 (Success)
User registration	POST:/user/register	The user object	200 (Success)	200 (Success)
Update user	PUT:/user/{id}	The user id; The user object	200 (Success)	200 (Success)
Delete user	DELETE:/user/{id}	The user id	200 (Success)	200 (Success)
Collecting User	GET:/user/count	There is no	200 (Suc-	200 (Suc-

Statistics			cess)	cess)
Obtain user information based on the token	GET:/user/getLoginInfo	JWT token	200 (Success)	200 (Success)
Restore the deleted user	PUT:/user/refresh/{id}	The user id	200 (Success)	200 (Success)

6 Conclusion

This paper mainly studies several key technologies of intelligent learning platform based on Spring Boot. From the demand analysis of intelligent learning platform system, including the technical analysis of the system, such as the current popular and efficient front and back end separation architecture as the technical support of intelligent learning platform. According to the functional requirements of the system, five functional modules including user information module, user interaction module, data analysis module, course video module and notification management module are divided, and the corresponding use cases are designed. Aiming at the non-functional requirements of intelligent learning platform system, it is committed to achieving the goals of reliability, safety and good performance. For each module of the intelligent learning platform system, the detailed design work is carried out, including the overall architecture design, database design and business module design. By building and developing intelligent learning platform based on Spring Boot back-end project and vue.js front-end project, to complete the platform system design work. Finally, for each module of the intelligent learning platform system, the interface test is completed by Swagger, and the function is tested by black box, and the corresponding test results are listed, so as to realize the intelligent online platform management scheme. As for the direction of future research, the platform system is deployed locally, so its capacity to process traffic is limited. In future research, it can focus on enterprise cloud server and consider distributed deployment scheme.

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