Application of Intelligent Course Selection Recommendation System Based on IPv6

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Abstract—**Aiming** at the problem university students in the process of selecting course are blind and inefficiency because of a lack of course selection guide, based on the traditional collaborative filtering algorithm based on the similarity between the users, through the historical data of students' course selection, the personalized course recommendation of students can be realized. **In** this paper, by collecting and analyzing the students' courses selection data, comparing suitable recommendation algorithm, design and implement an Android applications running under IPv6 environment, to provide students with personalized course recommended, course management, personal information management services, improve the quality of course selection and the efficiency of the students.

Keywords-H'vti; collaborative filtering; intelligent course selection; android APP

I. INTRODUCTION

In today's education model of colleges and universities, in order to meet the different needs of students' development, a variety of elective courses are provided, and students in colleges and universities need to select courses according to the professional training plan and their own development needs.Students usually face dozens of electives in different subjects during their college years.However, in the course of course selection, most students lack sufficient understanding of various elective courses, so they cannot quickly choose the courses they really need and like in the face of numerous elective courses.As a result, a large number of students choose courses blindly, which is not conducive to the improvement of students' comprehensive ability, but also affects teachers' teaching arrangement and reduces the use of school teaching resources.

Collaborative filtering recommendation algorithm is one of the main algorithms in e-commerce recommendation system.Based on the data analysis of students' history course selection, hobbies and interests, major, study and research direction, this paper recommends personalized elective courses for students and improves the success rate of course selection by collaborative filtering recommendation algorithm and user similarity evaluation.This paper designs and realizes intelligent course selection based on the Android mobile phone application *(APP)*, provide students with course information, personalized recommendation, schedule query, history test scores query, the test time query, personal information management and other services, not only let the students be able to select high quality courses, improve students' achievement and personal ability, but also convenient to students query information and manage courses, improve their learning efficiency.

As more and more mobile devices are connected to campus network in colleges and universities, more IP addresses are needed to meet the demand.This paper uses dual-protocol stack technology and address resolution to complete the identification and processing of the address of the *APP*, and uses the application interface supporting IPv6 protocol to realize the operation of the APP in IPv6 environment.

II. RELATED TECHNOLOGY

A. Next Generation Internet IPv6

IPv6 has 128-bit address space, 4 times the length ofIPv4, and only 2 times the header of IPv4, which ensures high efficiency in processing in the intermediate routing and supports a large number of network nodes [1].IPv6 offers wireless applications that greatly support the development of mobile apps with large address Spaces.It can assign a unique IPv6 address to all mobile devices connected to the network, and its network security also ensures the user's operation security to the mobile APP and the security of user information [2-3].

B. Android Software Development

Android is an open source mobile phone operating system developed by Google. It has a broad market prospect in China and a relatively mature consumer group. Moreover, Android system has been widely used in smart devices such as mobile phones and tablets, with a wide range of applications.

Android software development is the process of designing and developing the Android software or the software part of the system according to the user's requirements.Android Studio is Google launched an Android open integrated development

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environment, function is very powerful, not only can install all kinds of plug-in, using Gradle build project, for Android with a

refactoring and fast repair function, can capture performance, version compatibility problems, and ill editor function can support dragging preview layout, to achieve rapid development.

In general, a simple Android application consists of Activity, Content provider, Service, Intent, and so on.The Activity is equivalent to a Windows application's dialog window or a web application's web page window.Content providers can store data for multiple applications.Service and Activity are independent of each other and can keep the Service running in the background. An binding mechanism of the Intent runtime is used to describe the program function, Activity jump, etc. [4-6].

C. *Collaborative Filtering Algorithm*

Through the analysis of the user's historical data, the collaborative filtering algorithm based on finding a user set similar to the user's interests and hobbies in the relevant user groups, and integrates the evaluation of a certain item by similar users, thus forming a prediction of the user's preference for this item [7-9].In this paper, user-based collaborative filtering recommendation algorithm is adopted to provide personalized course recommendation for users.Based on the user information, the user attributes table is established. The user attributes table is used to calculate the similarity between the user and other users, and then the course set selected by the other user with high similarity is recommended to the user to realize the personalized recommendation of the course.

III. OVERALL DESIGN

A. *Overall Architecture Design*

APP system adopts similar *CIS* architecture, and mobile terminal ill realizes user interface, which generally includes information request and return, data display and other functions.The back-end server side realizes the business logic and data processing, concentrates the calculation amount on the server side, and improves the operation speed of the program.

To sum up, the whole design is divided into Android App client and Web server.The overall architecture diagram is shown in Fig. 1:

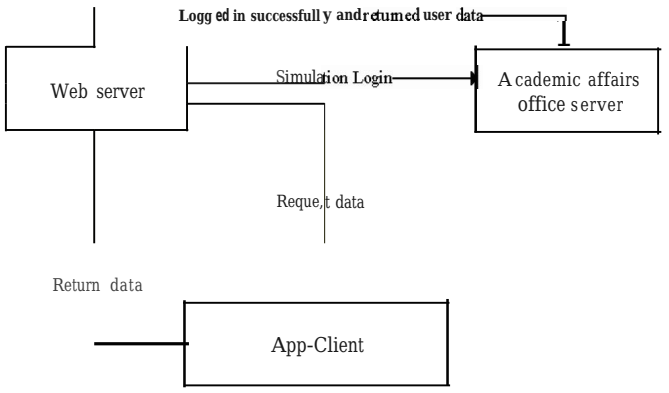

Figure 1. Overall architecture diagram

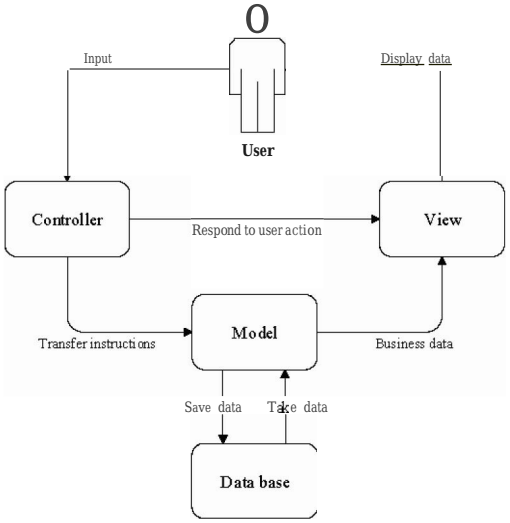

Figure 2. MVC architecture diagram

B. *APP Development*

1) *AndroidApp part*

In this paper, the APP client is designed with the common model-view-controller (MVC) architectural pattern to separate the business logic, data and interface display [lO].The three core components of the application, model, view, and controller, handle their own tasks independently and without interference, as shown in Fig. 2.MVC is more of an idea, ranging from the code organization structure to the front end and back end. All of them use the design idea ofMVC to make each other independent. The independent development or development of each module will not affect the normal use of other modules [11-12].The MVC architecture diagram is shown Fig. 2.

Key technologies for APP development in this paper are as follows:

a) data persistence: As mobile terminals cannot access data anytime and anywhere like Pc. In order to enhance user experience, save user traffic and use App without network status, SharePreference and Sqlite are used to cache network data in development. SharePreference accesses simple types of data in the form of key-value pairs. Sqlite is a lightweight database in Android and is an acid-compliant relational database management system used to store complex data.

b) user authentication: In order to avoid the user need to log in every time, the App uses Token way to interact with the server, when we after logging in for the first time, the server will return a JSON string, if the user account and password is correct, it will return the user's Token, use SharePreference save to Android native, when user login next time, will be added to the request Token head directly, can directly obtain the data needed.

c) data analysis: The data returned in the background is mainly JSON file, and the App uses FastJSON to parse the JSON data.FastJSON is an open source framework for parsing strings in JSON format by alibaba, which supports serialization of Java beans into JSON strings or deserialization of JSON

strings into javabeans [13-14].FastJSON is not only fast, easy to use, well-tested, but also very simple and easy to use API.

d) OKHTTP framework: OkHTTP is an open source framework for handling network requests as an alternative to Android's official network request API.OkHTTP support HTTP2, HTTPS, Socket circuit automatic selection, share a Socket, reduce the number of requests, support the PUT, DELLETE, POST,GET request methods, such as file upload, etc. In order to more convenient to use, we has carried on the summary to OkHTTP in development of encapsulation, makes him easier to use, the user login automatically set the Token into the request first, after the GET and POST interface automatically access Token, request for network, simply introduced into a small parameter.

2) Web server-side

a) background environment construction based on flask ofpython lightweight framework:The server diagram is shown in Fig. 3.

b) build WebApi interface based on JWT protection: JWT(Json Web Token) defines a concise, self-contained method for communicating information safely between parties in the form of Json objects [15-16].The schematic diagram of JWT is shown in Fig. 4.

The client APP requests the server to get the Token. When the client APP visits the server next time, it can access the data that needs authorization on the server with the Token.Token can save the customized information, such as the user's account name, password and other basic information. At the second login, the Web server can get the basic information of the requesting user by parsing TokenJWT can also easily solve the problem of cross-domain authorization because cookies cannot be Shared across domains, but using JWT can perfectly solve this problem.

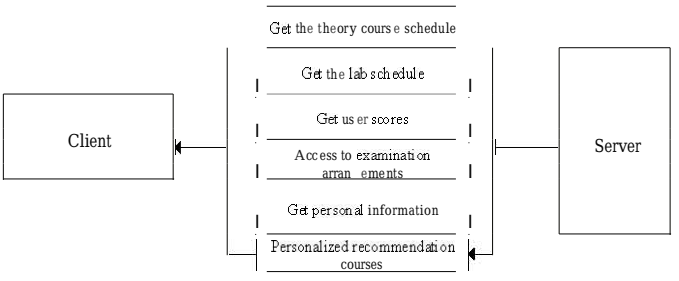

Figure 3. Web server framework

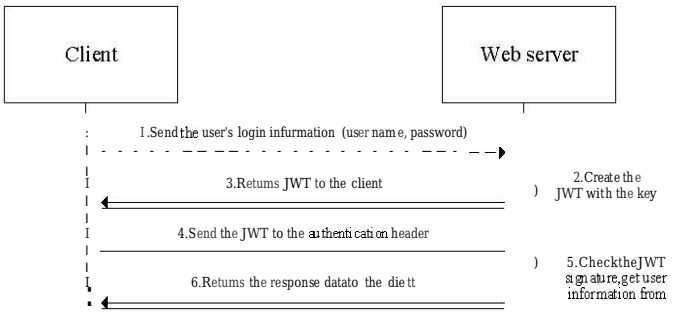

Figure 4. JWT schematic diagram

c) *Obtain the curriculwn schedule, grades, personal information and exam arrangement interface:* Through the Requests library of Python and use the user's account and password simulate login to the school academic affairs office site, web page data of the current user can download after a successful login, then use Pyquery library theory to clean curriculum schedule, history course grade, personal information, test schedule data from the downloaded web pages.

d) Recommend course data interface: The course data of the current user can be obtained after the user simulated login, and the course selection data can be transferred to the API interface of user-based collaborative filtering recommendation algorithm to recommend courses for the user. Detailed description of the recommendation algorithm is given in chapter 4.

C. System Function Design

The APP initially has four major functions, including personalized course recommendation, user curriculum schedule, message notification, personal information, etc., as shown in Fig. 5. After successful login, the user enters the personalized course recommendation page by default. The user can view the current recommended courses ranking and click the course details to learn about the courses.The user's schedule page displays the user's schedule for the current week of the current semester.The information notification page provides the information display of the office of academic affairs, examination notice, system notice and so on.The personal information page displays the user's profile picture, student number, signature and other personal information.

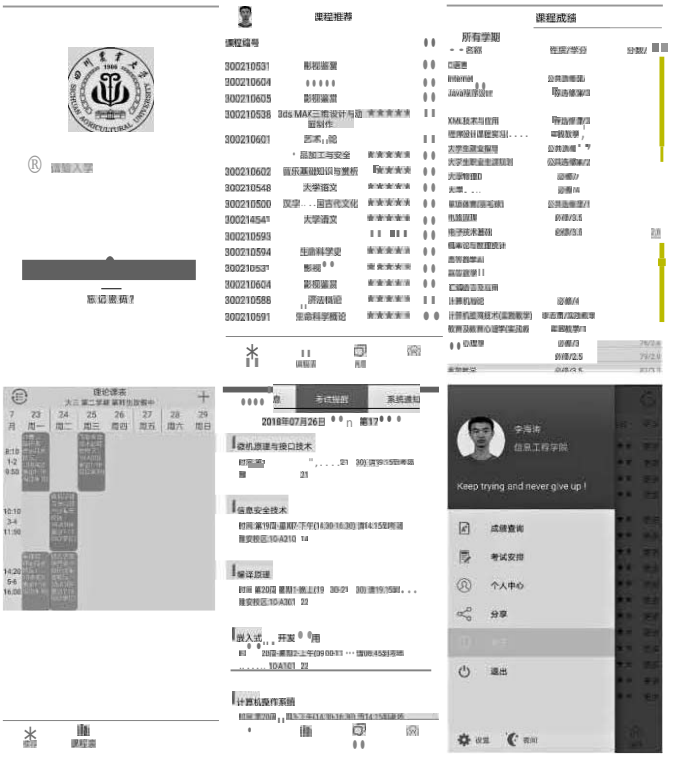

Figure 5. Main interface diagram of APP

1) Login and authentication

Mobile APP user oriented campus, only after the user access to the campus network can open the APP, enter the login page, enter the school academic affairs office account and password, the account information to the server, the server side through simulation on school academic affairs office, analyze H'I'Ml, web page, access user's information, personal schedule, grades, test data such as, and return to the APP client, the client display user's data.

2) Personalized course recommendation

After the user login system, server obtains user history course information, according to the user information to establish user attributes table, by calculating the similarity between the user and other users, and then high similarity of the user's choice of course is recommended to the user, personalized for user to recommend the highest interest the first N of course.

3) Course management

The course management function provides users with course management services, including the function of course schedule display, examination time query, and all examination results query, so that users can view the curriculum form in real time through the APP and improve the user experience.The second page of the APP homepage is the user's curriculum schedule, showing the current weekly schedule of the user's current semester, including course name, place and time.The slide menu page allows users to view the current term exam schedule, as well as the course scores for all history courses.

4) Personal information management

After the campus user login, the system automatically reads the user's name, student number and profile picture from the user basic information table and displays them on the personal page in the sidebar menu.Users click on the personal information page to enter the modification page. They can select the image to change their profile picture from the album or take photos, and edit personal information such as signature through the edit button.

IV. RECOMMENDATION ALGORIlHM

A. User-based Collaborative Filtering Recommendation Algorithm

After studying various mainstream recommendation algorithms, it is found that user-based collaborative filtering recommendation algorithm is more suitable for school course recommendation.By collecting student information and course information as the analysis data, and analyzing the "like-minded" students' data as the recommendation basis of current students, the personalized course selection recommendation of students can be realized.[17].The main steps of the user-based collaborative filtering recommendation algorithm are as follows:

- Get the course selection data of user groups;
- Find the target users who have the same interest according to the course selection data of the user group;
- Find the courses that the source users like in the target user set, and the source users have not selected, and recommend to the source users;
- Collect the user's satisfaction score for the recommended courses, and take the user's score data as the parameter of the next recommended courses.Do noise reduction for the recommended courses;
- End of algorithm recommendation process.

B. Algorithm implementation

1) Find a set of users with the same interests as each user

In the process of similarity calculation, this paper uses the cosine similarity formula to calculate the similarity between users [18].If N(u) is set as the course data set of user u's selected courses, and N(v) is set as the course set of user v's selected courses, then the similarity between two users can be calculated by the cosine similarity formula [19] :

$$w_{uv} = \frac{|N(u) \cap N(v)|}{\sqrt{|N(u)| \times |N(v)|}} \quad (1)$$

Let's say we now have four users A, B, C, D and six courses a, b, c, d, e, f. The courses selected by users are shown in Tab. I.

The course selection data from the above table can find the target users with similar interests for each user.For example, the most like-minded users with user A are user B and user D.Users A, Band D have taken courses a, band c.In other words, users A, Band D are all interested in courses a, band c, so we can conclude that users A, Band D have the same interests.Then, course data set of users Band D removing the existing courses of user A can be used as the recommended course data of user A [20]. In practical application, when the number of users is large, the similarity between users is calculated through the cosine similarity formula, and then the similarity threshold value W is set to select the similar user set of A user, and select the K users with the highest similarity, and finally recommend the selected courses of K users to A user.

2) Recommended course

First, most similar K users to the target user u should be found from the matrix. Represented by set S(u, K), all the courses selected by the user in S should be extracted, and the couse selected by u should be removed.For each candidate item i ,the

TABLE!. USER COURSE SELECTION TABLE

User A	User B	UserC	UserD
Course a	Course a	Course a	Course a
Course b	Course b	Course b	Course b
Course c	Course c	Course d	Course c
	Course d	Course e	Course f
	Course e		

degree of interest of user u in it is calculated by the following formula [21] :

$$p(u,i) = \sum_{v \in S(u,K) \cap N(i)} w_{uv} \times r_{vi} \quad (2)$$

Where r_{vi} represents user v's liking for i courses, the default value is 1, and it will be replaced by the user's score later, Suppose we want to recommend courses to user A, and select K = 2 similar users, and the similar users are: B, D. Then the courses that they have selected and A has not selected are: f, d, e. Then calculate peA, f), peA, d) and peA, e) respectively, and user A's interest in course f, d and e can be obtained [21]. In the later recommendation process, we can directly arrange the similarity sets of the courses they are interested in by descending order, and recommend the first N courses for users, then we can use the user-based collaborative filtering recommendation algorithm to recommend courses for users.

V. CONCLUSION

This paper designes and implementes a intelligent elective courses APP based on IPv6 network, and combine personalized recommendation technology, simulation technology, IPv6 technology used in it. On the basis of realize the basic function such as query, by collaborative filtering recommendation algorithm based on user to realize recommendations personalized courses, course management and use of personal information management functions to improve user experience, also convenient for the user to the daily management of curriculum. Not only does IPv6 have sufficient 128-bit address space to effectively address the IPv4 address shortage, but it also has great advantages in network security, identity authentication and support for mobile devices to obtain IP addresses, However, there are also some deficiencies in this study, When collaborative filtering recommendation is made, APP will still face the problem of sparse data and cold start, we will address these issues in future research.

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