Design of Mobile Learning Service Platform Based on Data Mining

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Abstract: The current mobile learning service platforms are mostly self-centered, and they provide exactly the same learning content, and their personalized service capabilities are insufficient to meet the different learning needs of different students at the same time. To this end, combined with data mining technology, the research on a mobile learning service platform that can provide personalized services is conducted in this paper. The platform design includes four parts, namely frame design (development frame design and network architecture), main hardware design (microprocessor, switch, memory), main software design (user registration and login program, personalized mining analysis program, online learning procedures, online communication procedures) and system testing. The test results show that the concurrent performance and compatibility performance of the system meets the requirements after testing, allowing multiple users to use different mobile clients to access the platform at the same time.

Keywords: Data mining; Mobile learning; Service platform

1. Introduction
Subject to time and space constraints, students' learning is mainly completed on campus, so learning time and learning efficiency are greatly shortened and reduced. In order to break the limitations of the traditional learning model, with the development of Internet technology and smart mobile technology, various mobile learning service platforms have emerged. The mobile learning service platform is supported by mobile Internet technology and digital technology and can organize a variety of learning resources. Users can use modern communication terminals, such as mobile phones, PDAs, and other equipment to conduct remote learning systems anytime and anywhere [1]. The design and application
of the mobile learning service platform are of great practical significance for promoting the popularization of education in our country, establishing a lifelong learning system, and realizing the leapfrog development of education.

Experts and scholars at home and abroad have conducted research on the design of mobile learning service platform. For example, Li Shuqin, Li Min, and Ma Shilai integrated the business system functions of the multi-mode teaching network and the practice teaching network by building a server on campus, and docked with WeChat server, designed a mobile teaching service platform based on WeChat enterprise account; Li Yongjie proposed the design and implementation of an Android-based mobile learning system, which provides an interface for users to access through the client installed on the mobile phone, and truly achieves the goal that users can learn anytime, anywhere; Gu Suiqing, Gao Weifang, Xia Jianchun and others have designed a mobile learning platform design for the field of medical teaching. Medical students can use mobile phones or computers to access the Internet to obtain learning guidance and services, which improves their learning achievements. The University of Helsinki in Finland has designed and implemented a UniWap mobile learning system. Students and teachers can access learning resources anytime and anywhere through WAP phones or smartphones; Mamat, Kamaruddin, Azmat, and Farok have designed and developed a mobile learning system based on the Android platform using the Java programming language. Students can learn at their own speed through routers and switches at any time and anywhere; Frederick Ako-Nai, Frederique Pivot, Dr. Kinshuk, and others use the 5R adaptation framework to enable the mobile learning system to provide the correct content to the correct learner through the appropriate equipment, at the appropriate place and at the right time.

Although predecessors have developed many mobile learning systems for students to choose and learn, most of these systems are self-centered and they provide exactly the same learning content. Some even just pile up the content of the teaching materials without fully considering the individual needs and learning habits of the students, resulting in the lack of individualization of the services provided, which cannot stimulate students' interest in learning, and the learning effect is not obvious. In response to the above problems, this article applies data mining technology to research a mobile learning service platform that can provide personalized services. The platform design includes frame design, hardware design, and software design. Finally, the test proves the effectiveness of this system.

2. Design of mobile learning service platform based on data mining
With the development of Internet technology, students' learning methods have become more and more diversified, and the mobile learning service platform is a typical representative of the current background. The mobile learning service platform has many advantages, which greatly facilitates students' learning, but the learning platform is not perfect and has certain shortcomings. The details are shown in Table 1 below.

| Features     | description                                                                 |
|--------------|-----------------------------------------------------------------------------|
| Advantages   | Good compatibility, any mobile client can be connected and used.           |
|              | Learners can study anytime, anywhere, without being restricted by time and space. |
|              | Mobile learning is a fragmented experience. The knowledge learned is fragmented and fragmented. Learners can make full use of trivial time. |

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With the universality of educational objects, anyone can use the mobile learning model to carry out learning and communication.

| Disadvantages | Learning resources need to be further developed. |
|---------------|--------------------------------------------------|
|               | Most of the existing learning resources are packages of traditional learning resources in the form of mobile learning, and there is a lack of personalized learning resources for mobile terminals, learning objects, and learning content. |

**Tab.1** Comparison of advantages and disadvantages of mobile learning service platforms

In view of the analysis results in Table 1, this article combines data mining technology to design a mobile learning service platform that can provide personalized services. Data mining technology refers to the process of extracting potential and valuable knowledge (models or rules) from a large amount of data, including data collection, preprocessing, mining, and analysis [2].

2.1. Platform frame design

The system framework design is a sketch of the system, describing the abstract components that make up the system and how each component communicates. These components can be refined into actual components such as classes or objects in the implementation process. The frame design of this system is divided into the development frame design and network architecture design [3]. There will be a separate analysis below.

2.1.1. Platform development framework design

In order to facilitate the later module design of this system, the three-tier architecture model (model-view-controller) is selected as the development framework of the mobile learning service platform.

- **Model:** The main function is the processing, modification, storage, and access to central data;
- **View:** The main function is to display information through an interactive interface;
- **Controller:** The core layer, which acts as a link between the upper and lower layers, is responsible for analyzing user instructions, reading data, controlling user input, data receiving and sending, etc. [4].

2.1.2. Platform network architecture design

The network architecture refers to the topological structure of the connection of each communication node. Since this platform is divided into two parts: online learning and communication and interaction, the internal and external network switching model is adopted for network layout, as shown in Figure 1 below.
2.2. System hardware design

The construction and implementation of any application system are inseparable from the support of servers, storage, switches, and other physical equipment, and this system is no exception [5]. In this chapter, several key hardware devices of the system are introduced.

2.2.1. Microprocessor

Microprocessor is a central processing unit composed of one or a few large-scale integrated circuits. It plays a central control role in the entire system and is equivalent to a small computer. Taking into account technical factors and cost factors, this system chooses an ARM9 embedded microprocessor [6].

The processor technical parameters are shown in Table 2 below.

| Name                  | Parameters                                                                 |
|-----------------------|-----------------------------------------------------------------------------|
| CPU processor         | amsung S3C2440A, main frequency 400MHz, 533Mhz;                             |
| SDRAM memory          | 64M SDRAM; 32bit Data Bus; SDRAM Clock frequency up to 100MHz               |
| FLASH storage         | 256M Nand Flash, Non-volatile; 2M Nor Flash, Non-volatile, BIOS installed   |
| Interface and resources | 1 100M Ethernet RJ-45 interface; 3 serial ports; 1 USB Host; 1 USB Slave B type interface; 1 SD card storage interface; One stereo audio output interface, one microphone interface; One 10-pin JTAG interface with 2.0mm pitch; 4 USER Leds; 6 USER buttons; 1 PWM control buzzer; 1 adjustable resistor for AD analog-to-digital conversion test; 1 I2C bus AT24C08 chip for I2C bus testing; 1 2.0 mm pitch 20pin camera interface onboard real-time clock battery; Power interface (5V), with power switch and indicator; |
| Clock source          | 12M passive crystal oscillator;                                             |
| Real-time clock       | Internal real-time clock (with backup lithium battery)                      |
Extension port | 1 34 pin 2.0mmGPIO interface;  
| 1 40 pin 2.0mm bus interface;  

Operational support | Linux2.6.32.2 + QtE4.6.3 +Qtokia-2.2.0;WindowsCE.NET 6.0(R3)  

Tab.2 ARM9 embedded microprocessor technical parameters

2.2.2. Switch

The switch is a kind of network equipment for information forwarding. By accessing the switch, the communication between each node and the system platform can be realized [7]. The switch in this system is a 24-port full Gigabit Poe switch. The features of the switch are as follows:

First, high-speed caching, data lossless: adopts store-and-forward mode, provides 56Gbps backplane bandwidth, provides large-capacity cache, effectively reduces data forwarding delay, improves forwarding efficiency, and avoids data packet loss;

Second, Gigabit transmission is stable and high-speed: The CPU uses high-performance RTL8382L+2 RTL8218B+RTL8214FCo to provide 24 10/100/1000M adaptive RJ45 ports, all ports support line-speed forwarding, and data transmission is fast and stable;

Third, the port is automatically flipped, plug, and play. According to the type of network cable incorporated, it can automatically perform MD/MD|X flip and automatically negotiate the port operating rate, plug and play;

Fourth, the flexible VLAN function can easily divide the network; VLAN port isolation makes the network more convenient, efficient, and safe;

Fifth, it has the function of a PC connection, which can be directly connected to the PC to realize various operations and services of the switchboard;

Sixth, the POE power supply makes networking more convenient. The maximum output of a single port is 30W, and the power supply of the whole machine is 250W.

2.2.3. Storage

Due to the huge number of integrated learning resources in the system, if they are directly stored in the system, it will take up a lot of system space, bring a huge burden to the system, and slow down the system's operating speed. To this end, a peripheral device is needed to expand the system memory. The storage in this system is enterprise-level network storage, and its performance advantages are as follows:

1) With Intel Xeon CPU, the performance is better;
2) Use DDR4 memory to improve performance;
3) Built-in SATA DOM, the operating system starts faster and safer;
4) Support wake on the network, support link aggregation;
5) AES-256 support, extremely fast encryption and decryption transmission, greatly ensuring data security;
6) Compatible with SATA and SAS hard drives, providing users with more choices;
7) Redundant power supply design realizes automatic switching of dual power supplies, making machine operation safer;
8) Support IPMI2.0;
9) Hardware supports RAID 0, 1, 5, 6, 10, 50, 60;
10) Support Single Disk/JBOD mode;
11) Support external SAS expansion;
12) Have 12 hard disk bays;

2.3. System software design
The system software is the logic program that the system runs, plays the role of guidance and logic control. The logic operation program of this system mainly includes several parts such as user registration and login program, personalized mining analysis program, online learning program, online communication program, and so on.

2.3.1. User registration and login procedure
The user registration and login procedure are mainly to ensure system security and prevent the learning resources from being lost or stolen. Only after successfully logging into the system can you learn on the platform [8]. The basic flow of the user registration and login procedure is shown in Figure 2 below.

![User registration and login procedure](image)

Fig.2 User registration and login procedure

2.3.2. Personalized mining analysis program
Students have different learning abilities and different learning needs. Therefore, the system must have
the ability to teach students in accordance with their aptitude, and provide different learning content for different students by digging out the different interests of students. The addition of personalized mining analysis programs makes the system more humane and intelligent [9]. The block diagram of the personalized mining analysis program in this system is shown in Figure 3.

![Block diagram of the personalized mining analysis program](image)

**Fig.3** Block diagram of the personalized mining analysis program

The process of using data mining technology for user personalized discovery is mainly divided into four parts. First, collect user browsing records; Second, pre-process it, including data purification, user identification, session identification, path supplement, and transaction identification, etc., to improve data quality; Third, establish a user session database based on the Weblog file; Finally, mine the user's preferred access path, learner clustering, and learning page clustering, and combine the above to form a knowledge base about users, and use these knowledge bases to implement personalized recommendations for learners [10].

2.3.3. Online learning program

The online learning program refers to the process in which users choose to continue their previous learning or choose new learning content based on recommendations, as shown in Figure 4 below.
Fig. 4 Online learning program
2.3.4. Online communication program
The online communication program is a program designed for interaction and communication between teachers and students. The block diagram is shown in Figure 5 below.

![Block diagram of online communication program]

In addition to the above-mentioned key programs, it also includes an information release subsystem, score management sub-programs, and background management subsystems. No specific analysis will be made here.

3. Platform performance test analysis
In order to find system operation problems and find the difference between actual results and expected results for improvement, this chapter conducts system performance testing.

3.1. Platform test environment

| Name                  | Test environment                      |
|-----------------------|---------------------------------------|
| Operating platform    | Operating system Microsoft Windows2000, Microsoft Windows98 |
|                       | WEB server Microsoft IIS5.0, Microsoft Active Server Pages |
3.2. Platform concurrency test

There may be many people logging in and using the mobile learning service platform at the same time, so its concurrent performance must pass the test to meet the learning needs of multiple people at the same time. For this reason, it is necessary to conduct concurrent performance testing on the learning service platform. The concurrency performance test results are shown in Table 4 below.

| Number of concurrent users (pcs) | Average response time (s) | Average number of concurrent users (pcs/s) | Request success rate (%) |
|---------------------------------|---------------------------|------------------------------------------|--------------------------|
| 50                              | 0.263                     | 12.36                                    | 100                      |
| 100                             | 0.785                     | 11.02                                    | 100                      |
| 150                             | 1.036                     | 10.68                                    | 100                      |
| 200                             | 1.236                     | 10.22                                    | 100                      |
| 250                             | 1.365                     | 9.63                                     | 100                      |
| 300                             | 1.523                     | 9.25                                     | 100                      |
| 350                             | 1.635                     | 9.14                                     | 100                      |
| 400                             | 1.722                     | 8.25                                     | 100                      |
| 450                             | 1.782                     | 8.02                                     | 100                      |
| 500                             | 1.823                     | 7.23                                     | 100                      |
| 550                             | 1.925                     | 6.36                                     | 100                      |
| 600                             | 2.425                     | 5.53                                     | 100                      |

Tab.4 Concurrent performance test results

From Table 4 above, it can be seen that 50 to 600 users will continue to access the platform within 3 minutes by 50 users. The response time of the platform server to the event is completed within 3 seconds. The response speed of the platform is very fast, and the request success rate is up to 100%, achieved the expected goal.

3.3. Platform compatibility test

Since different users use different mobile devices, the system must have good compatibility to meet user needs. This system selects several different mobile devices to access the system and judge whether it is operating normally to check platform compatibility. The results are shown in Table 5.
below.

| Mobile devices | Test results                                      |
|----------------|--------------------------------------------------|
| Huawei Nova    | Successfully connected to the platform and operating normally |
| Xiaomi 3       | Successfully connected to the platform and operating normally |
| Samsung S6     | Successfully connected to the platform and operating normally |
| Noblue note3s  | Successfully connected to the platform and operating normally |
| OPPO R11       | Successfully connected to the platform and operating normally |
| iPhone 11      | Successfully connected to the platform and operating normally |
| vivo S6        | Successfully connected to the platform and operating normally |
| iQOONeo3       | Successfully connected to the platform and operating normally |

Tab.5 Platform compatibility test results

Taking several common mobile platforms on the market as an example, visiting the mobile learning service platform designed in this article, these mobile terminals have successfully connected to the platform and are running normally, which proves that the designed system is compatible.

4. Conclusion

The design and application of the mobile learning service platform break the limitations of time and space for students to learn and provides a more effective platform for students to learn. The current mobile learning platforms are mostly self-centered, lack personalized services, and cannot "teach students in accordance with their aptitude." To this end, this article combines data mining technology to study a mobile learning service platform that can provide personalized services. Finally, after testing, the platform performance meets the demand. In this development work, there are also some shortcomings, that is, the use of system memory is not efficient enough, and the system fluency needs to be improved.

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