Analysis of Mobile Learning Model and Design of Mobile English Platform Based on Service-Oriented Architecture

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Abstract

On the basis of extensive reading of domestic and foreign literature and full investigation, this paper studies the theories related to mobile learning. Based on these theories, the resource service model of cloud education resources and the mode of mobile English learning are designed, which forms the problem of identification and confirmation with practitioners. Design models and solutions produce new theories of mobile learning. On the system architecture, the system is divided into four layers to improve the flexibility and scalability of system services. Considering the security of system services, a set of session caching system is designed and proposes a service interface encryption scheme based on Sessionid, Timestamp, and public Key. Finally, this paper realizes the mobile English client and background management platform. English mobile platform is used widely for teachers and students on campus, so the pressure-bearing capacity of the system service is tested and verified. The results show that the running stability of this system can reach about 96.03%. Its bearing capacity is strong, reaching the expected goal, which can provide some reference for related research.

1. Introduction

Learning techniques and methods have gone through the stages of development from simple to complex, from low level to high level. The main factors that determine learning technology and methods are as follows: (1) media technology, from oral language, written language, printed materials, radio and television to computers; (2) communication and communication technology, from word of mouth, written records, mass media, radio communication to computer network communication. The rapid development of the new generation of information technology and its universal application in colleges and universities have promoted the profound changes of campus informatization [1]. At the same time, with the popularization of intelligent mobile terminals and the development of high-speed communication networks, mobile learning will become the main trend of learners’ learning style in the future. The key of SOA (Service Oriented Architecture) is the concept of “service.” W3C defines service as follows: a service provider completes a set of work and delivers the required final results for service users [2]. In addition, with the development of mobile communication technology and other wireless access technologies, and the popularity of wireless and mobile devices, mobile learning has been gradually realized and is becoming a learning method for people. Learning is a way in a mobile learning situation. Relying on the mobile communication network and wireless network, it pushes learning resources to mobile terminals such as mobile phones and iPad for learners to learn anytime and anywhere [3]. Learning features such as mobility, high efficiency, extensiveness, interactivity, sharing, and personalization make learners no longer confined to the computer and can realize “anytime, anywhere, and with them.” At present, mobile learning platforms in colleges and universities emerge in endlessly, and the services provided are also different. Among them, there are many excellent platforms, but there is still room for optimization and promotion [4].
and career development in knowledge economy society; and the concrete application of mobile communication technology [5] in education. Mobile learning resources are more and more extensive, and mobile devices are cheaper and cheaper, so the unconscious application of mobile learning will eventually be integrated into people’s life and study [6].

On the one hand, intelligent mobile terminals bring convenience but also pose challenges to management and information security. On the other hand, the traditional teaching platform is basically oriented to the learning mode of fixed places, lacking the services and functions oriented to mobile learning, which has certain defects. For example: (1) the degree of teaching resources is limited, and there is a lack of resource sharing mechanism for coconstruction and sharing. Most resources can only be opened to authorized users. (2) It cannot provide good multilateral interaction function and effectively support learners’ mobile learning. (3) It cannot effectively support the use needs of diversified terminals. Smartphones can be connected to the network at any time, and they are easy to carry. Under this background, it is necessary to design and implement a mobile English learning platform with the help of mobile Internet and other technologies [7]. Aiming at the problems existing in the traditional learning platform, this paper proposes a mobile English learning platform based on SOA. The innovations of this paper are as follows:

(1) Based on the orientation of mobile learning, this paper investigates and analyzes the present situation and existing problems of mobile learning, analyzes the mobile learning model, and builds an English learning platform based on SOA in the mobile environment, taking the advantages of educational platform in mobile learning and its transformation to mobile learning as the starting point. This paper attempts to solve the problems of mobile learning at present and expands the research perspective of mobile education application.

(2) This paper designs a mobile English learning platform based on SOA to realize the unified management of mobile learning applications. In the data layer, MySQL-Redis storage system is adopted. In the aspect of service security, the encryption scheme of API service interface is designed. It can provide decision-making support for school management and is conducive to the improvement of teaching management level.

2. Related Work

For mobile learning, there are two technical options: short message oriented and connection oriented. They are not constrained by time or space, and they will ensure that the quality is maintained. For global mobile communication operators and mobile equipment suppliers to open up markets, mobile learning has become an important application research topic. In order to conduct mobile learning research, some educational institutions actively collaborate with well-known mobile communication operators and mobile equipment suppliers. Furthermore, many scholars have made significant efforts in the theory and application of mobile learning, with some promising results.

Liu proposed an SOA-based digital teaching resource management architecture, and took the system access control service as an example, they gave the design and implementation of a typical service process [8]. Martinez et al. design a mobile learning platform based on SOA. It includes single sign-on, intelligent management of mobile learning applications, and statistical analysis of operational data [9]. The platform can facilitate the use of users and effectively manage the progress of mobile learning applications. Ono et al. used the services provided by the cloud education platform to solve the problems existing in mobile learning and designed the resource service model of the cloud education resource supermarket and the two types of mobile learning models supported by the cloud education platform, informal learning and formal learning [10]. Li proposed a point-to-point anomaly detection scheme based on device token, which can detect the multiple point-to-point cases of a single device switching account [11]. Based on the characteristics of the educational resource recommendation system, Sung et al. added the learner’s personality characteristics and learning style characteristics to the collaborative recommendation algorithm to achieve educational resource recommendation [12]. Traxler et al. proposed the system architecture of resource personalized service, designed a mobile learning platform model based on cloud education, and proposed the architecture and service model of cloud education resource supermarket [13]. Sefid-Dashti et al. put forward the requirements and goals of the mobile teaching assistant platform in colleges and universities and then analyzed the service performance that the platform needs to provide. Finally, they proposed a layered service-oriented architecture scheme [14]. Thramboulidis proposes personalized course resource recommendations. The main functions of the system include user registration and login, course retrieval, viewing browsing history, recommending courses, sharing learning materials, course scoring modules, and background management functions [15]. Through the analysis of the two major elements in teaching, the roles of teachers and learners in the system, Teich et al. studied the learning methods in the mobile environment and planned the modules of the system, discussed the whole teaching process, and proposed learning resource organization models and propagation models [16]. Based on the connotation definition and feature analysis of mobile learning, CAD theoretical model, and the functional requirements of college English mobile learning, and supplemented by the analysis of the new curriculum reform requirements for college English and the characteristics of college students’ learning, Wang et al. put forward college English mobile learning system model [17].

This paper takes English vocabulary learning in mobile environment as the research object, designs the cloud education platform which embodies the concept of “cloud education,” constructs the mobile learning mode, and analyzes the application scheme of mobile learning. Finally, on this platform, some examples of teaching resources are
developed. This paper explores the learning methods of mobile English in the mobile environment from two aspects of theory and practice. This research can provide reference for the design, development, and implementation of other similar mobile learning systems; help to create a good teaching environment by combining teaching with mobile learning; and improve the teaching quality and learning efficiency.

3. Methodology

3.1. Analysis of Mobile Learning Model Based on SOA. SOA describes the component structure of a program or system, the interconnection among components, and the principles and guidelines for managing the design and evolution of components [18]. SOA is a software architecture guided by the service-oriented principle. SOA model is to replace the functional modules in traditional large-scale applications with the concept of functional services. These replaced modules will link the good interfaces and contracts defined between services [19]. SOA has some key features. For example, it is a loosely coupled software architecture, and services communicate through interfaces, without involving the underlying details of the system. The basic architecture of SOA consists of four parts: service provider, registration mechanism, service consumer, and service contract. SOA mainly describes three roles, specifically, (1) service provider, which publishes the calling contract and the location of the service provider; (2) service consumer; and (3) service directory. The basic element of SOA is service. When designing the system structure, everything is from the service point of view. First consider the service requirements and then assemble the system services. The whole software process is divided into service definition, description, publishing, discovery, binding, service arrangement, and call execution. As a coarse-grained, loosely coupled service architecture, services communicate through simple and precisely defined interfaces, which does not involve the underlying programming interfaces and communication models. You can also deploy, combine, and use loosely coupled coarse-grained application components in a distributed way through the network according to your needs. In the actual production environment, the functional business of the system often changes, and the services provided by SOA need to be able to quickly respond to these new requirements. When choosing the technical scheme, try to choose the technical scheme with high agility. The bottleneck of any link in SOA architecture will affect the service performance of the whole system.

Learning is a way in a mobile learning situation. Relying on the mobile communication network and wireless network, it pushes learning resources to mobile terminals such as mobile phones and iPad for learners to learn anytime and anywhere [20]. Mobile learning is mainly based on the theory of constructivism. The teaching and learning of mobile distance education is generally carried out through the mobile distance education environment. The so-called mobile learning environment refers to a kind of virtual environment suitable for distance learning generated by mobile distance education technology. Mobile learning can be regarded as using mobile devices to build a reasonable mobile learning environment with related learning activities. Therefore, we can analyze the characteristics of mobile learning from three aspects: mobile devices, mobile learning environment, and mobile learning activities. Mobile learning is a new form of distance education. It has five characteristics: (1) quasi-space–time separation between teachers and students; (2) professional organizations provide learning resources; (3) it is necessary to rely on information media; (4) provide two-way interaction; and (5) students are in a distributed independent state. Learning integrates authenticity, personalization, situational intelligence, multiple perceptual interactions, and demand learning, as well as new technologies such as multimedia, Internet, and mobile devices into the field of education and training. By analyzing the interaction between services, SOA can help application systems know when and why business logic is actually executed, which enables administrators or analysts to optimize business processes. SOA-based mobile English learning platform includes intelligent mobile terminal, mobile learning platform client installed on the intelligent mobile terminal, server, mobile application database and mobile learning platform server installed on the server, with mobile communication network as the running platform. Among all kinds of devices that help people live, study, and work, mobile devices have become an indispensable part of people [21]. This makes the mobile learning device itself has a good integration, and people do not have to choose additional learning devices in order to adapt to this new learning style. At the same time, the mobile English learning platform has strong personalized features. Everyone’s mobile device is exclusive and contains a lot of personalized information of users. The learning style that conforms to mobile learning must have three characteristics: first of all, it must be digital teaching content; second, it must have mobile media as a learning tool; and finally, teachers and students must be in a state of quasi-space–time separation, which is the criterion for judging whether it will become mobile learning. The learning system structure is shown in Figure 1.

The functions of SOA-based mobile English learning platform mainly include single sign-on, unified user and permission management integrated with directory server, mobile learning application management, statistical analysis of mobile learning application usage, statistical analysis of business data, and so on. From the aspect of content and form, there is no essential difference between mobile learning and digital learning and online learning. However, its mobility and context-related features make it a brand-new learning technology and method completely different from digital learning and online learning. Mobile learning needs to have three elements: a digital learning support environment, including information service infrastructure and learning terminals; second, digital learning resources, which can be opened and shared on the Internet after digital processing; third, digital learning mode, which will implement teaching activities with the help of information technology to complete students’ knowledge construction. The mobile English learning platform client supports
Android and iOS intelligent terminal operating systems. In the mobile Internet environment, all kinds of intelligent mobile devices can be connected to the network anytime and anywhere, and they are easy to carry. Under this background, aiming at the weakness of traditional learning platform, it is necessary to design and implement a mobile learning platform with the help of mobile Internet and other technologies. At present, the existing fixed distance learning system can be transformed into a mobile environment in some way to form a mobile learning system. Like digital learning, it will become an important choice form of school education, thus giving full play to teachers’ dominance and students’ subjectivity. According to the connotation and main mode of mobile learning, the SOA-based mobile learning platform can be designed according to three modules: browsing, local application, and publishing management. It can be accessed directly by the browser of mobile devices, local applications downloaded to mobile devices, and application publishing background management functions. Schools can analyze the use of mobile learning applications, strengthen the supervision of users of intelligent mobile terminals, and analyze the data to provide decision-making analysis basis for management, thus achieving the role of auxiliary management.

3.2. Design of SOA Mobile English Learning Platform. The design principles of SOA mobile English platform in this paper are as follows: (1) extensibility principle, (2) scientific principle, (3) safety principle, (4) principle of reliability, and (5) principle of openness. The learning system in China Mobile is designed using constructivist learning theory in this paper. The learner, as the system’s instructor and assistant of learning, learns independently and truly becomes the builder of knowledge. The campus information portal and the Java EE Web application are realised by the Web layer of the mobile English learning platform. Various business rules and logics are combined in the business process layer. Through well-defined interfaces and contracts between services, the campus information service bus connects different functional units of application programmes: create a centralised data center with an educational information resource server, a virtualized resource running environment, and user access terminals for cloud and mobile learning. This article states that when providing services to the outside world via service interfaces, a unified data format must be used. If multiple functions are linked, it is not possible to create new data access for a single function; instead, data access must be done by calling the appropriate service interfaces. Web service technology is used to build the software system architecture of the mobile English learning platform based on SOA. Its system architecture is shown in Figure 2.

The resource and management platform of the system is based on a standard WAP server and a short message server. It provides two forms of learners’ access: accessing WAP server through mobile Internet; access SMS server through SMS gateway. On the client side, mobile terminal devices with Internet access function are mainly used. The service layer encapsulates the functional components provided by the original campus system with web services. The new system provides web service interface and publishes these services to UDDI public directory server for registration, so as to provide directory routing services. On the data storage strategy, MySQL database is used as the main database to store massive relational structured data, and MySQL database cluster storage system is built to realize distributed data storage. The interface is defined in a neutral way, which is independent of the hardware platform, operating system and programming language that
implement the service, so that the services built in such a system can communicate in a unified and standard way. The mobile English learning platform coordinates the scheduling of three levels of resources; taking knowledge sharing as the starting point, we should establish an education-oriented cooperative sharing mechanism for core users who love knowledge and are willing to share and disseminate it, so as to meet the needs of “mobile learning” anytime and anywhere.

With the increasing number of campus intelligent mobile terminals and mobile learning applications, for some important mobile applications, if users install them manually, it may cause problems such as complicated installation, untimely installation and complicated modification of application configuration, which cannot ensure the timeliness and correctness of software installation. In this paper, the application of secure storage technology and data encryption transmission technology in the process of storing and transmitting information resources can effectively prevent the loss and leakage of user information and learning materials caused by virus invasion, insider leakage, abuse of administrator’s authority, and other reasons. At the same time, this paper adopts the strategy of double encryption of mobile client and server. Before submitting the registration information, the mobile client encrypts the password entered by the user with 32-bit md5 to ensure that the plaintext password is not exposed to the external network environment. Security software shall be installed and upgraded by compulsory execution. The intelligent mobile terminal executes the installation, upgrade, and uninstall of security software in the background without any prompt. In this system, students are the center of the system, actively acquiring knowledge and self-testing and can also carry out collaborative learning. Teachers guide and assist students’ learning, supervise and evaluate, and at the same time, design teaching and manage educational affairs. The administrator is responsible for the maintenance of the system, managing the information of students and teachers, etc. Operation data include mobile application log, application usage information, user identification information, intelligent terminal information, and GPS location information records. Through the unified background management platform, the operation data of mobile learning applications are statistically analyzed. The key link of pushing educational and teaching resources in mobile learning environment is from the cloud to the hands of users. Two questions need to be considered: one is what resources to push and the other is how to display them. This paper designs an interactive interface between users and cloud resource database, that is, integrated portal of mobile learning. This portal is used to display cloud resources, authorize users to log in, submit users’ requirements and other functions.

It is defined that the similarity of interest labels of user \( a \) and user \( b \) is represented by \( I(a, b) \), and the set of interest labels of user \( a \) is as follows:

![System architecture diagram of this paper.](image-url)
The set of interest tags of user $b$ is as follows:

$$I_b = \{I_{b1}, I_{b2}, I_{b3}, \ldots, I_{bm}\}. \tag{2}$$

Among them, the same number of tags is $k$, then the similarity $I(a, b)$ of the interest tags of user $a$ and user $b$ is as shown in the following formula:

$$I(a, b) = \frac{k}{m + n - k}. \tag{3}$$

The course preference similarity $J(a, b)$ of user $a$ and user $b$ is expressed as the following formula:

$$J(a, b) = \frac{h}{m + n - h}. \tag{4}$$

Suppose the user’s preference matrix for resources is expressed as follows:

$$\text{RM} = [r_1, r_2, r_3, \ldots, r_m]^T,$$

$$r_i = [r_{i1}, r_{i2}, r_{i3}, \ldots, r_{im}]. \tag{5}$$

Among them, $r_i$ represents the user’s preference vector for resource $i$, and $r_{ijn}$ represents the preference degree of user $j$ for resource $i$. The individual user vector model $U$ is defined as follows:

$$U = U(K_1, W_1, K_2, W_2, \ldots, K_n, K_n). \tag{6}$$

Among them, the keyword $K_i$ corresponds to the keyword $K_i$ of the individual user behavior model $P$, and $W_j$ is the user’s comprehensive interest in the keyword $K_i$. The definition of comprehensive interest degree $W_i$ is shown in the following formula:

$$W_i = \frac{C_i}{\sum_{k=1}^{n} C_k} + 1 - \frac{D_i - D_j}{\sum_{k=1}^{n} (D_i - D_k)}. \tag{7}$$

Among them, $C_i$ and $D_i$ are the number of visits and the latest visit time corresponding to $K_i$ in the individual user behavior model $P$, respectively, and $D_j$ is the current time. In the adjustment algorithm of the user personality feature library, the response ratio is defined as follows:

$$S_i = \frac{D_i - D_j}{C_i}. \tag{8}$$

Among them, $D_i$ is the current date; $D_j$ and $C_i$ are the latest access date and cumulative access times of the keyword, respectively. The strength of the user $P$’s interest in the resource $R$ can be represented by a certain distance between the resource vector $R$ and the individual user vector $U$. It is defined as the cosine $\text{Sim}(U, R)$ of the included angle of the vector, as shown in the following formula:

$$\text{Sim}(U, R) = \frac{\sum_{k=1}^{n} (u_{ik} \cdot x_{jk})}{\sqrt{\sum_{k=1}^{n} u_{ik}^2} \cdot \sqrt{\sum_{k=1}^{n} x_{jk}^2}}. \tag{9}$$

The persistence layer is located on the data layer, providing data services for the system business layer, and is the foundation of the whole system service. In this paper, the functions realized by the business layer are analyzed and abstracted and then the system data resources are divided correspondingly. By adopting the idea of SOA, the originally loose functions are linked through a unified and standardized data service interface. At the same time, a complete mobile learning system should have the following functional sub-modules: resource module, discussion module, question answering module, testing module, and other auxiliary modules. As the mobile English learning platform is open, the sources and types of users are diverse, so when users register, it is necessary to divide the roles of users according to their information and resource needs. SOA-based mobile English learning platform operation data statistical analysis function is divided into client data collection SDK and back-end data statistical analysis subsystem. Among them, the back-end data statistical analysis subsystem can be further divided into statistical analysis function module, application developer portal, and platform administrator portal.

### 4. Result Analysis and Discussion

A layered SOA is used to build the mobile English learning platform. This chapter puts the platform to the test in order to determine its viability. The client’s test environment consists of Opera8 and Winwap. These two browsers are currently the most popular for developing WAP systems, and systems that pass this test can be used on mobile phones normally. First, the interface’s address, port, path, and parameter information are set. The parameters are tested with online data in order to restore the actual environment as much as possible. The data-receiving module receives and analyzes the data packet collected by the mobile terminal; it is then stored in the platform’s basic data table via the database access interface according to the format. The survey results for the presentation mode of mobile courses are shown in Table 1.

As for the consumption subsystem, the active system can reach a balanced state, and the consumption subsystem will play a more important role. The performance of the system server directly affects the user experience of the mobile client, and the intelligent point-to-point function of the mobile English learning platform will generate a large number of concurrent requests, so it is necessary to ensure the reliability of the service. In this paper, a solution based on data read–write separation and server cluster is adopted to alleviate the pressure caused by high concurrency, and the stability and real-time performance of the system are tested. The stability test results of the system are shown in Figure 3. The real-time test results of the system are shown in Figure 4.

The results show that this system’s running stability can reach 96.03%. This system has excellent real-time performance. Based on the basic data table, the data statistical analysis module classifies, summarises, and generates statistical indicators to meet the needs of business functions. The database access interface hides the database type while providing access to the underlying database. The background management platform primarily performs information management functions such as editing and sending...
announcement information, manual management of user session information, and batch data import. Third parties can use the platform’s statistical data results by using the service development interface, which provides a statistical data access interface in the form of a WebService. The server cluster system is tested concurrently in this chapter, with an emphasis on the average response time and error rate of each test. The test results are shown in Figure 5.

From the analysis of the above results, the concurrency that the server cluster system can bear is about 2.1 w. In addition, the performance of a single application server in a cluster system is improved compared with that when it is used alone. The next step is to test the accuracy of resource recommendation of this mobile English learning platform. The results are shown in Figure 6.

It can be seen that this platform can effectively recommend learning resources, and its recommendation accuracy is high. In this system, learners can complete the learning division, role identification, resource collection and analysis, testing, discussion, asking questions, submitting exercises and homework online and in real time. Learners can cooperate with each other through words, sounds or graphics. In order to verify that the system can be effectively used in the learning environment, the system has been tried out. Table 2 shows the statistical results of questionnaires using the platform.

| Serial number | Presentation mode | Teachers’ opinions (%) | Students’ opinions (%) |
|---------------|-------------------|------------------------|------------------------|
| 1             | Audio frequency   | 69.54                  | 68.77                  |
| 2             | Video clip        | 52.34                  | 59.84                  |
| 3             | Text              | 54.12                  | 51.06                  |
| 4             | Game              | 41.26                  | 46.58                  |
| 5             | Animation         | 31.26                  | 33.27                  |
| 6             | Picture           | 26.84                  | 28.35                  |
According to the analysis in the above table, 94.35% of users are willing to use the mobile English learning platform constructed in this paper. At the same time, the system also recommended learning resources for them; Among them, 92.84% users are satisfied with the recommended learning resources. This is an ideal result. In addition, this paper collected the user's rating feedback. Figure 7 shows the user's usage rating data.

According to the experiment in this chapter, the mobile English learning platform based on SOA has higher user scores and better system performance. It provides a one-stop learning service. It includes five modules: learning system, resource recommendation, online question answering, evaluation module, communication, and interaction module, and realizes the integration of learning, recommendation, question answering, evaluation, and interaction. It can assist teachers, students, and learning resources to realize interaction at three levels: operation interaction, information interaction, and concept interaction. It is beneficial for learners to study, self-test, and communicate anytime and anywhere; at the same time, we can also publish learning resources to better serve other learners.

5. Conclusions

Small size, light weight, good mobility, complete digital processing ability, convenient information exchange, and obvious social attributes in mobile devices are all features of mobile learning. Mobile learning activities, on the other hand, are characterised by a variety of interactive methods, accessibility at any time, strong autonomy, and situational characteristics. This paper investigates and analyzes the current situation and existing problems of mobile learning, analyzes the mobile learning model, and builds an English learning platform based on SOA in the mobile environment, using the benefits of educational platforms in mobile learning and their transformation to mobile learning as the starting point. MySQL-Redis is used as the data storage system. The modular processing of business logic is designed in the business layer; the encryption scheme of the API service interface is designed in the service security layer. Finally, the system’s performance test reveals that the system’s operating stability is approximately 96.03%. It has a high load bearing capacity and has met its objective. This mobile English learning platform is a one-stop shop for all of your English needs. It consists of five modules: a learning system, a resource recommendation system, an online question answering system, an evaluation module, a communication, and interaction module, and it integrates learning, recommendation, question answering, evaluation, and interaction. Learners can study, self-test, and communicate whenever and wherever they want; at the same time, we can publish learning resources to better serve other students. This platform can be used to combine teaching and mobile learning in order to improve teaching quality and learning efficiency. This work can provide some reference for related research. However, mobile learning is an interdisciplinary research field involving mobile communication technology, computer science, pedagogy, psychology, and so on. At the same time, due to the time problem and my limited knowledge level, there are still some shortcomings in this research. How to optimize the server performance is one aspect that needs to be studied in the future.

Data Availability

The data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author does not have any possible conflicts of interest.

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