

Design and Research of Android Mobile Learning System With the Support of GAE

Jun Han, Huibin Yin, Jing Liu and Jing Dong

Department of Educational Technology, Capital Normal University, Beijing, China
James_han@sina.com, Yinhuibin@gmail.com, fionaliujing@163.com, dj6466@126.com

Abstract—Cloud computing and software development for handheld devices are two very hot technologies that are increasingly being combined to create hybrid solutions. With this article, introduce a mobile learning system based on Android platform and use Google app engine (GAE) as the server end. Since the mobile terminal devices are resource-constrained, a reasonable system structure was designed, and some key technologies such as data processing, user interface and courseware browsing were also analyzed.

Keywords-Mobile Cloud Computing; M-learning; Android ; Cloud Computing

1. Introduction

The past couple of years have seen an explosion in innovation, making 2009 an interesting year for technology. Two of the exciting innovations have been cloud computing and mobile application development [1]. Cloud computing on distributed commodity platforms, like Google App Engine and Amazon EC2, is perhaps the most exciting new trend in Web 2.0 application development. Instead of requiring a dedicated high-reliability server farm, with all the associated costs and complexity, a commercial cloud platform allows applications to be built and hosted on an as-needed basis [2]. As exciting as the cloud "back end" architecture has become, the availability of powerful, low-cost hand held mobile platforms have brought as much excitement to the "front end" [2]. Hand-held devices like the iPhone and Android put services at hand that were unimaginable just a few years ago.

However, compared with desktop terminals, mobile terminals remain weak in the following aspects, such as, computing power, storage capacity, screen size, network speed, and operation. And the above factors should be fully taken into account in the design of mobile learning systems in order to achieve optimum design [3]. The mobile learning system designed in this paper is based on the Android platform and it achieved such functions as course learning, courseware browsing and management, knowledge base query.

2. An Overview of Mobile Cloud Computing

A new study from ABI Research, titled "Mobile Cloud Computing", has revealed that "cloud computing" will completely transform the way mobile applications are being developed, acquired, and used. "Cloud computing" will dramatically reduce the requirement of advanced handsets for running mobile applications, according to the study. The mobile applications that will lead the growth, the key technologies, players and initiatives involved. Also included are forecasts of subscribers and revenue by region and application category using mobile cloud applications [4]. The report theorizes that the cloud will soon become a disruptive force in the mobile world, eventually becoming the dominant way in which mobile applications operate [5].

Mobile internet and cloud computing together is "mobile cloud computing", which actually is cloud computing in the mobile internet. Although "mobile internet" and "cloud computing" are well known, their combination, "mobile cloud computing" is still not being mentioned in China [6].

2.1 Mobile Internet Needs Cloud Computing

1) *The limited storage capability of mobile terminals needs the support of cloud computing*

Generally speaking, mobile internet refers to the way that people have access to the internet through wireless method based on portable devices. The features of portable devices decide the difference of mobile internet from traditional internet, hence the difference of mobile cloud computing from cloud computing. Portable device is usually personalized (from form design to operation system kernel), and its CPU processing power, memory, keyboard, screen, battery and bandwidth, esp. Storage and computing capability are limited, subject to the requirement of size and portability. One advantage of the “cloud computing” is the powerful storage and computing capability provided by the “cloud”. As long as the portable device has input and output data exchange with the “cloud”, there will be an unexpected effect even though its performance is not high [6]. There is no doubt that mobile internet needs more of cloud computing, but only if cloud computing must adapt to the various features of portable device, meeting with and addressing its shortcomings.

2) *The personalized requirements of mobile terminals system need the solve of cloud computing*

The popular operating systems of current portable devices are Windows Mobile, Windows CE, Symbian S60, Linux, iPhone, Android. The Feature Phone can only accept K-Java program. Also there are various versions of these operating systems. Moreover, many manufactures did some customization. So it can be said that the operating systems of portable device is still in the Spring and Autumn period---there is no unity in the operating system. When we develop an application in portable device, considerable efforts will be spent on code porting and testing if we want it to cover a certain percentage of mobile phones. So a “thin” or simple client is needed if we want to develop the application quickly. Simple client means a lot of data processing in “cloud”, hence the design of the technical architecture should be in accordance with the cloud computing model. Meanwhile, the design of user interface should take full advantage of the interface of the platform itself, or the transplanting of UI will drain much of your energy. Therefore, most applications of mobile cloud computing is realized through the Brower, but also a considerable portion is achieved through a variety of Widget. We can assert that human-computer interaction through voice or other types of sensing technologies will spread, and the technical support must be mobile cloud computing [6].

3) *The consumption of the battery and internet traffic needs optimization of cloud computing*

If an application consumes much electricity and internet traffic, then it will be difficult to be promoted in portable device. Mobile cloud computing is a magic weapon to solve the consumption problem of electricity and internet traffic in portable device [6]. That is to reduce the battery and traffic consumption effectively through reducing the frequency and amount of data exchange between portable devices and “cloud” which can be achieved by optimizing the “cloud”. For all kinds of real-time message or reminder services, push technology is also crucial; however the polling techniques popular in PC cannot migrate to the portable devices. Again, mobile cloud computing is a great tool to achieve better push technology. It can be predicted that push service platform providers will appear and be quite successful, because they can resort to mobile cloud computing and make full use of its technical interface.

2.2 Typical Case Study of Mobile Cloud Computing

With the help of mobile cloud computing Google’s mobile phone navigation systems, mobile voice search system and various services on the Android platform are admirable to us. It is worth mentioning that Motorola launched MotoBlur service in October 2009, which is a typical use of the mobile cloud computing. MotoBlur integrate the traditional SMS into one with Gmail, Twitter, Myspace, Facebook. And via MotoBlur users can link with the outside world anytime through a small screen.

UCWEB and Hesine are the models of China mobile cloud computing. UCWEB internet users can feel the fast flow and the low consumption. And the technical backup is the first-class page conversion technology, through which the normal web page is processed before sent to the mobile phones. The rate of webpage conversion and the ratio of data compression are totally due to the cloud computing platform of UCWEB. Hesine is a kind of real-time news service software, which is based on wireless internet. Through mobile cloud computing, Hesine can guarantee the real-time news push as well as minimizing the consumption of battery and traffic. Take Hesine’s customer-grasping service as an example, any selected text and image can be downloaded onto the mobile phone or sent to friends immediately after the right click. Using a very small

client, Hesine not only provides individual users with push-off, express mail, magic letters, housekeeper, focus on customers and other features, but also provides open push-off platform (OPEN API)to internet company. The former integrates phone and the internet closely, and the latter extends the internet to mobile phone, which shortens the time and saves the cost in mobilizing the internet. All this is due to the adoption of mobile cloud computing model in product design from the very beginning.

2.3 GAE Platform and Android Platform

1) *GAE platform*

GAE, as a new generation of cloud computing-based webapp development platform, enables its users to develop and operate web applications within the Google infrastructure. GAE is easy to build and maintain, and can be easily expanded based on user access traffic and data storage needs. The employment of GAE makes maintenance server unnecessary: it could immediately provide services for users, as long as the developers upload their application. The developers can share with the world their applications, and can also restrict them to authorized users [7]. The features of GAE in the following aspects are:

- In the aspect of application environment, with GAE, applications that can safely run will be easily built even in a circumstance of data overload.
- With respect to security, GAE introduced Sandbox Technology. Sandbox will isolate the application in its own safe and secure environment which has nothing to do with the hardware, operating systems and physical location of the network server. Application running in its safe and isolated environment will only provide limited access to the basic operating system. These limitations allow App Engine to distribute across multiple servers network requests of applications, and to start and stop the server in order to meet the traffic demand.
- As for databases, GAE provides a powerful distributed data storage service, Big Table, which contains the query engine and transaction capabilities. The distributed database will grow with the data, just as the distributed network servers grow with the access demand.
- About language environment, as early as April of 2008 when GAE was first released, it provided a running environment which uses Python programming language. In April 2009, GAE already announced support for Java language.

2) *Android platform*

Android is a software platform and operating system based on Linux kernel, with Google as its early developer and Open Handset Alliance as its later developer [8]. It adopts software stack (also known as software-laminated) architecture which consists of three parts. Low-level part is based on Linux kernel and provides only basic functions; other application software is developed by the companies themselves, with Java as part of the programming [9]. In addition, in order to promote this technology, Google, and dozens of other phone company has established the Open Handset Alliance. Android was often rumored as Google phone or GPhone before its being released publicly. It was regarded as Google's own mobile phone, instead of a software platform. Google began to publish its own branded mobile phone Nexus One from January 2010, and now the best is Android 2.0.

3. The Design of Android Mobile Learning System with the Support of GAE

The mobile learning system, as the extension and complement of the existing digital learning system, is mainly oriented for those people who have fast pace of life, high job mobility, little learning time. Through the use of mobile devices, such group of people can do the operation rather than on PC.

3.1 System Architecture

The system consists of system management module and the mobile client, the diagram shown in Figure 1. The system management module is one of the existing digital learning systems, through which the module manager carries out the management of mobile learning. Such management includes adding mobile learning courses and courseware, posting bulletins, and viewing the learning state [10].

Mobile client refers to the client software used by the learners on mobile terminals, and it can connect the application server to complete the relevant learning operation through wireless mobile network (GPRS, CDMA, etc.), Wi-Fi wireless networking, and PC data cable synchronization.

3.2 System Architecture Design

Different from the desktop applications, it is difficult for mobile applications to operate directly on the database under the restrictions of network conditions and mobile terminals performance. So usually distributed architecture system is used to ensure the system has good usability, scalability, and framework-level clarity [11]. This system uses the distributed software architecture of logical 5-layer and physical 3-tier, as shown in Table 1.

TABLE I. THE SYSTEM HIERARCHICAL STRUCTURE

Logic layer	Physical layer
Client Layer	Mobile terminal equipment , Based on the Android platform
Presentation Layer	Application Server , Achieved using GAE
Business Logic Layer	
Database Operations Layer	
Database Layer	Database server, using JDO implementation

3.3 The Design of Mobile Client Module

Mobile client mainly consists of the following modules: mobile-side login module, resource data module, collaborative interaction module and Services-supporting module [12].

1) Mobile-side login module

The system includes three types of users: learners, teachers and administrators.

Once the users are in the login page of the mobile terminals, they need to enter a user name and password for authentication. If the user is already registered and enter the information correctly, then he will logged in successful to the learning system; but if the login fails, the login page will prompt the user for confirmation, and the user needs to re-enter a user name and password. If a user hasn't registered yet, he needs to fill out registration information in the terminal to register.

After entering the learning system, the user needs to input user name and password again for authentication if he wants to enter teaching platform. If the user is a registered user and enter the information correctly, he will successfully log onto the teaching platform; if the login fails, the login page will prompt the user for confirmation, the user needs to re-enter a user name and password. A new user needs the administrator's approval before he can log on. Teaching platform users are logged on the three types of divided authority.

In this module, langue completes the teaching platform login. And the basic information on the login interface is set in this module, such as user name, password, background, color, borders, fonts, etc. When using the mobile terminals to run the learning system, the user's information is stored in the terminal database as a data element. A variable is set to ensure that there will not be a repeated display of login window after the login.

2) Resource data module

This module is mainly responsible for the user's interactive operations with the procedures, including accepting user's input operation, doing validation and simple logic processing, obtaining the corresponding data from GAE. And the final data will be displayed with the appropriate manner to the user.

"My Courses" in the mobile terminals includes four parts.

- Curriculum video. It provides mainly the lectures of teachers to the learners. Each video slip is of 20 minutes or so, and the teaching contents follow the principle of progressive difficulty. Also material of different topics is provided here for learners to learn and review, which can help them make full use of fragmented time. Learners can accept and memorize the presentation easily thanks to the clear objectives.
- Notice. It provides learners the most timely and relevant information, such as seminars, curriculum changes, homework submission, examination results, schedules of group activities. Also it can combine memory rules to push information to learners, which will help learners consolidate their learning.

- Reading resources. The resources are in the form of text and picture, and classified according to topics.
- Practice resources. It is in the form of simple text and pictures for learners to review and exercise. Also it provides learners self-test environment to deepen understanding of learning content.

3) *Collaborative interaction module*

In this module, the interaction between various users and services is achieved. The interaction mainly includes that of users and learning contents, learners and teachers, learners and learners, learners and learning interface. Such mutual cooperation and collaboration will encourage end users to further enhance learning. Overall interactive and cooperative activities can be roughly divided into bulletin boards, forums, resources, and other related functional modules area. Students can use mobile devices anywhere, anytime to have access to bulletin boards to obtain notice, lesson content needing mastering, information and resources requiring previewing. In addition, teachers can send teaching notice to learners' terminal devices in the form of mass mailing, as well as posting them on bulletin board to remind the learners that "in this system, the teacher is authorized with such managing as sending teaching notice".

With the same form as that of the network forum, the discussion area of mobile learning system has the advantage of enabling learners to make use of their fragmented time to interact. Teachers develop a theme in advance, and then post on bulletin board the time of discussion, as well as sending short message to inform the learner. In the specified time, teachers and learners visit the learning platform, and discuss the subject of prior agreement. During the discussion, learners can use the system browser to visit the Internet without withdrawing from the forum, which makes it possible for the learners to search information and resources useful for the ongoing discussion.

4) *Services-supporting module*

The services-supporting module can personalize the service according to the different requirements and habits of users. Specifically speaking, such personalization can be achieved through analyzing such data as the collection of user preferences, user data processing, and the current state of the user. The user habits will be obtained through such analysis, and better service type will be provided to users.

Every time a user logs onto the system, the server will automatically record the user's learning history, and the search habits. So next time when the user logs onto the system, the server will provide superior service by calling the user information stored in the GAE cloud.

GAE cloud can record information of a new user, and do a comprehensive analysis of user's personality according to the use of time, keywords-searching habits.

In addition users can also make a backup of the data to prevent the data loss from the system's accidental withdrawal, which ensures the integrity of the data, reducing the user's data loss. There are two ways to make the backup of data in GAE: If the database is in use, then call command and create a file containing necessary command and data to re-create the local database; if the database is not in use, the database file can be copied directly to a safe location in GAE.

4. Conclusion

Aimed at the characteristics of mobile applications, the paper designed android mobile learning system based on GAE cloud computing. System uses a distributed multi-layer structure, using GAE cloud computing platform as the background to optimize and store data. At the same time in the mobile client's design, the performance, display effects and other factors were considered. Corresponding technical was selected according to different scenarios, in order to bring users a better user experience.

5. Acknowledgment

The author appreciates the support from Training Program Foundation for the Talents of Beijing (095403900) and the Beijing Education Committee Project (KM201010028022)

6. References

- [1] N. Gift, J. Saggau, Connecting Apple's iPhone to Google's cloud computing offerings. <http://www.ibm.com/developerworks/web/library/wa-aj-iphone/>. Jan 2009.

- [2] C. Martin, Integrating Google App Engine with iPhone. <http://www.infoq.com/news/2009/02/appengine-iphone>. Feb 2009.
- [3] W. Q. Xiong, B. Yang, Design and Implementation of Mobile Learning System Based on Windows Mobile Platform. *Computer Knowledge and Technology*, vol. 5, pp. 9724–9726, December 2009.
- [4] D. Narain, ABI Research: 'Mobile Cloud Computing' the Next Big Thing. <http://ipcommunications.tmcnet.com/topics/ip-communications/articles/59519-abi-research-mobile-cloud-computing-next-big-thing.htm>, July, 2009.
- [5] S. Perez, Why Cloud Computing is the Future of Mobile. http://www.readwriteweb.com/archives/why_cloud_computing_is_the_future_of_mobile.php, August, 2009.
- [6] J. H. Tao, Mobile cloud computing will become a mainstream mode of mobile Internet. <http://it.sohu.com/20091228/n269266509.shtml>, December, 2009.
- [7] Google Code, Run your web apps on Google's infrastructure [EB/OL]. <http://code.google.com/intl/en/appengine/>.
- [8] L. Gong, C. Zhou, Development and Research of Mobile Termination Application Based on Android. *Computer and Modernization*, vol. 156, pp. 85–89, August 2008.
- [9] Y. Chen, L. F. Jiang, Research of Mobile Development Based on Google Android Platform. *Fuzhou Computer*, vol. 11, pp. 156–158, November 2008.
- [10] W. Hou, D. M. Zhu, Research on the Practice of Developing Technologies on Mobile Learning. *Modern Educational Technology*, Vol. 20, pp. 115-126, January 2010.
- [11] J. Zhou, Design and Development of Mobile Learning System. Beijing Jiaotong University, Master thesis, June 2009.
- [12] Y. H. Yao, Research and Development of the Mobile Learning Terminal Platform Based on Android. Central South University, Master thesis, October 2008.

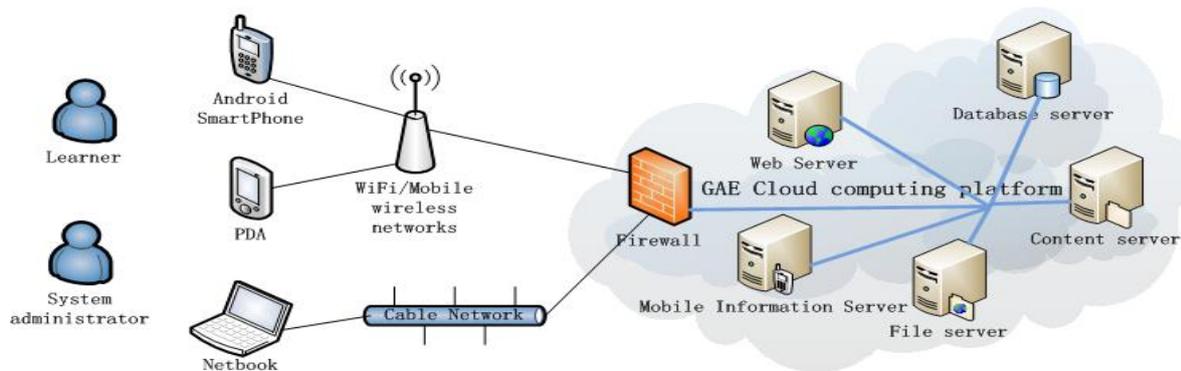


Figure 1. System Architecture