Design and Implementation of Pharmacopoeia Smart Learning System Based on Android Platform*

Liao Chunhua, Pen Lin, Du Jianqiang and Li Zhibiao

School of Computer Science, Jiangxi University of Traditional Chinese Medicine, Nanchang Jiangxi 330004 China
lch0422@163.com

Abstract - Pharmacopeia is the national statutory medication guide, rich in content, but the structure is complicated. Pharmacopeia learning system based on traditional resources are limited time, place, and therefore learning is inconvenient. The purpose of this paper is to develop the smart learning system possible for learner-centered, self-directed and interaction-oriented by using BYOD of learners. The developed system is configured with application for Android-based smart phone or tablet PC and application for Data Storage on web server. And using SOAP technology, Android device communicated with WEB platform. Smart learning system is designed to contain basic adaptive learning system and advanced adaptive learning system. Moreover, the system has overcome obstacle in pharmacopoeia learning which described above by providing various retrieval methods.

Index Terms - Android platform, Smart learning system, Chinese Pharmacopoeia (CPH), SOAP

1. Introduction

CPH which contains vast knowledge of herbs and drugs, was legal Medication Guide. But for now, these data have not been fully universal use because there exist some limitations in the forms of data dissemination. Following are several transmission ways of CPH now: (1) Paper publications: the data are high accuracy and authoritative. However, there are limitations in time and space. And the users are mostly the medical colleges of teachers, students, health workers and researchers. (2) Electronic documents (such as PDF and WORD document): there are no constraints of dissemination in time and geographical, but there is no database search function, the user sense of experience is poor. And because of WORD documents are modified easily and the data are lost easily too, there exist problems of data consistency and security. (3) WEB resources: It could provide the retrieval of the Pharmacopoeia data, and the users are very widely, it could provide preliminary knowledge for learners. The disadvantage is that there are some restrictions of learning from in time and place because it does not together with mobile devices.

In short, since the learning resources are not shared fully, interactive learning cannot be achieved, and learning in anytime and anywhere cannot be achieved. The limitations of transmission modes of CPH must be broken through so that users can learn anywhere and anytime.

Bring Your Own Device (BYOD) including mobile phones, tablets, PCs, etc. By using smart terminal, learners could access to resources and learn by any device at anytime and anywhere. BYOD allows us to enter the era of personal mobile learning. It means the facilitation of individual IT equipment as the auxiliary means for work undertaking while using the general PC provided by business for major work terminal as a new trend of facilitating individual IT equipment for work affairs and it is facilitated as an educational tool [1].

Google has just unveiled new Android[2] BYOD management tools for enterprise IT teams to help them improve and tighten their management of user devices in the workplace. Furthermore, the Android-based devices may be used as much as possible. Thus, Android-based devices could be considered the most suitable BYOD.

2. System Design

A. The Architecture of System

Using the technology of object-oriented software engineering, an adaptive learning platform for the drug information of CPH has been established. In this system, different modules adopt respectively the common B/S or C/S architecture [3]. The system architecture is shown in Fig.1.

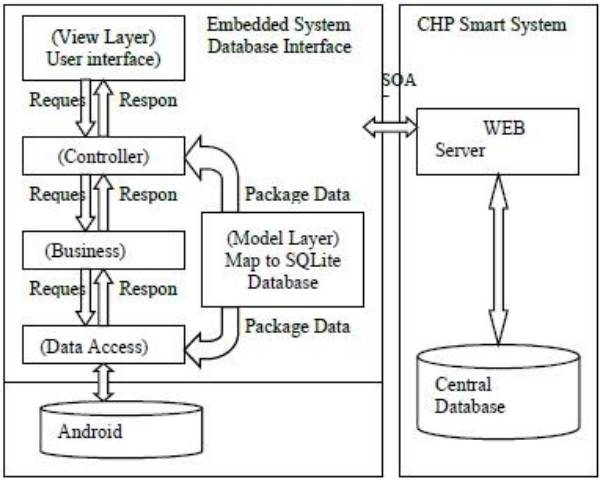

Fig. 1 System Architecture

Combining Android-based mobile platform with SQLite database technology, the system achieve a variety of learning ways about drug information of CPH on Android mobile devices. Meanwhile, in order to promote the efficiency of transmission, the learning forum module is designed to enhance communication between users. Due to the centralized, highly real-time, as well as data exchange frequent, massive

* This work is partially supported by Traditional Chinese Medicine scientific research fund of Jiang Xi province Department of Health Grant #2003A193 to Liao Chunhua and Jiang Xi university of traditional Chinese Medicine science and technology project Grant #2013ZR0073 to Liao Chunhua.

data and other features, the supporting data of Forum Systems is not suitable for stored in SQLite database. In order to construct a complete learning forum and achieve the management of users and privileges, the system provides a powerful WEB background support. These data will be stored in the background large relational database of WEB. Using SOAP [4] technology, Android device communicate with the WEB system, to complete the interaction and synchronization of these data.

B. System Function Modules

The system expects to implement the adaptive learning on pharmacopoeia knowledge and improve communication between learners. The entire System is divided two core modules: Pharmacopoeia retrieval module and learning forum module. And others modules are registration module, user management and forums maintenance module. Here introduces Android smart learning function requirements. First, Combined with the characteristics of the Android platform, the adaptive learning knowledge base must adopt a lightweight database technology. Here we use the SQLite database technology which meets the requirements of lightweight. Second, for the purpose of adaptive learning, the system provides a variety of different forms of learning. The smart learning system is divided into basic adaptive learning and advanced adaptive learning. The basic adaptive learning section includes: name keyword retrieval, directory keyword retrieval, the united keyword retrieval and antibiotics retrieval. Advanced adaptive learning section includes: full-text retrieval and indications queries. Third, the interactive data in Learning Forum are not suitable for stored in SQLite database came with Android platform. Thus, this system uses HTTP communication technology to store these data in large-scale relational database commonly used in WEB platform. Functional modules of system are shown in Fig.2.

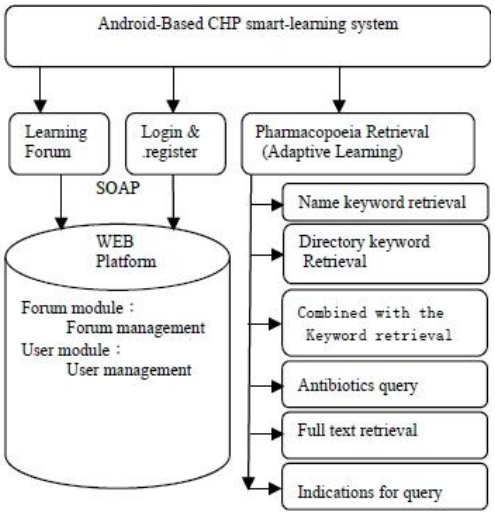

Fig.2. System functional modules

C. The central CPH Database Design

For learners, the CHPs' data are too mass and complex to process. Therefore, there usually exists a gap between CHP Comprehensive utilization and the choice of drugs in CHP adaptive learning and teaching nowadays. In order to overcome the problem described above, we must research a way of digitally stored. A central database has been established based on TCM theory in the server side, which includes the CHP basic entities like prescription, Antibiotics, syndrome, herb, treatment, etiology, and so on.

3. System Implementation

A. Android software stack

Fig. 3 illustrates the Android software stack [5], which consists of a Linux kernel, a collection of Android libraries, an application framework that manages Android applications in runtime, and native or third-party applications in the application layer. The following list specifies these Android software stack components: A Linux 2.6 kernel manages core services Which provides an abstraction layer between the hardware and the rest of the stack; Various C/C++ core libraries running on top of the kernel; The core libraries and the Dalvik virtual machine, the Android runtime is a runtime environment for normal Android applications; Dalvik is a register-based virtual machine that is optimized to ensure the efficient and stable operation of multiple instances; Application framework which provides the classes used to create Android applications; and application layer. All applications, both native and third-party, are built on the application layer using the same API libraries. The application layer runs within the Android runtime using the classes and services available from the application framework.

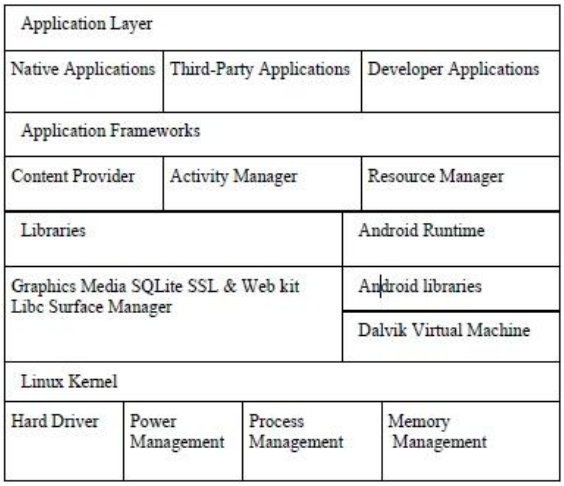

Fig.3. System functional modules

B. Hardware configuration

The Android device with the Qualcomm snapdragon processor clocked at 2.3GHz includes a 3GB RAM, a 16GB flash memory and a WVGA800 capacitive touch screen with the resolution of 480×800 pixels. The available data exchange techniques include Bluetooth, Wi-Fi, ExtUSB, WCDMA, GPS etc. [6]. In the debugging stage, a simulator can be set up in the PC, in which the Android application can to debug directly.

C. Software Configuration

Android offers new possibilities for mobile applications by offering an open development environment built on an open source Linux kernel. The Open Mobile Alliance (OHA) [7] and Google support the Android platform and hope to reach the goal of ensuring global mobile services that operate across devices, management/deployment, rich class-sharing, proprietary vehicular applications, security policies, and more. Geographies, service providers, operators, and networks.

Google has already released the open source Android platform, providing the opportunity to create new adaptive mobile platform interfaces and applications designed to look, feel, and function as desired. Consequently, the Android platform has recently been ported into mobile devices, such as notebooks, PDAs, and automotive systems.

D. CHP Data Storage and Management in Device

For ensuring the device worked offline normally, the CHP information is managed efficiently by an embedded database SQLite1.3 in the mobile device [8][9]. SQLite system, coded with C programming language, is an open-source database engine, which is entirely independent with primary OS, and offers supports to most of SQL92 standards. In this database, the maximum size of a single data file may reach 2TB, and it has excellent performance of query and insert. The SQLite database architecture is shown in Fig 4.

User Interface	User API, SQL Lexical, Grammatical , Semantic parser
VM	Relational Algebra Engine VM Code Compiler VM Instruction Execution
Storage Management	B-Tree Management and Storage External Memory Page and Buffer Memory Page Management
OS Interface Layer	Kernel Call Interface

Fig.4. the architecture of SQLite database

E. Mobile Data Synchronization

The data Synchronization is one of the most important techniques of an embedded database, which includes some key issues like maintenance of GUID, maintenance of modified metadata, exchange of modified data, detection and elimination of data conflict, and so on. In this system, the synchronization module is secondly developed on SOAP framework [4], an object-oriented technology that defines a standard protocol used for exchanging XML-based messages, to ensure the consistency of the heterogeneous databases when the CHP data has been updated in subsystems. It is defined as protocol specification for exchanging structured information in the implementation of Web Services in computer networks [10][11]. The specification defines an XML-based envelope for exchanging messages and the protocol defines a set of rules for converting platform specific data types into XML representations. This framework consists of five main building blocks [12].

1) Web Service Servlet: deploys new services into the mobile device and invokes the requested service. The flexibility of allowing Web Service developers to customize the particular handling of requests and responses is also supported by it.

2) HTTP Listener: The main functions of it include listening to incoming requests through Server Socket class, accepting incoming client's requests, initiating new thread for each request to support concurrency and creating input and output stream for communication.

3) Request Handler: The main task for it is to process the request. In SOAP-based MWSF the request handler will unwrap the incoming HTTP POST request to extract the hidden SOAP envelope then it will dispatch the envelope to the message parser.

4) Parser Module: The main function for it is to get the needed information for invoking a Web Service such as the name of the service, service URL and some parameters. Then the extracted information is sent to the Service Servlet. In SOAP-based MWSF, the SOAP parser desterilizes the SOAP object and maps the data types into Java objects using kSOAP2 and kXML2 that are open source APIs for SOAP parsing.

5) Response Composer: It is responsible for interpreting the result then sending it back to the client.

F. The Implementation of Android Application

An important feature of Android is that one application can reuse the part code of other applications. Furthermore, this application needn't incorporate the part code or link to it. And it can start up that part code when the call arises, that is Android must start an application process when any part of it is needed, and instantiate a Java objects for that part code. Therefore, Android has essential components that the system can instantiate and run as needed, which are four types of components named Activities, Services, Broadcast Receivers and Content Providers[13]：

1) *Activities:* An activity represents a single screen with a user interface. Although the activities work together to form a cohesive user experience in the email application, each one is independent of the others. An activity is implemented as a subclass of Activity

2) *Services:* A service is a component that runs in the background to perform long-running operations or to perform work for remote processes. A service does not provide a user interface, but rather runs in the background for an indefinite period of time. Activity can start the service and let it run or bind to it in order to interact with it. A service is implemented as a subclass of Service

3) *Content Providers:* A content provider object makes a specific set of the application's data available to other applications. The data can be stored either in a file system or an embedded database.

4) *Broadcast receivers:* A broadcast receiver is a component that can receive and react to broadcast announcements. For example, announcements when the battery is low and when the time zone has changed.

The following presents the directory keyword retrieval

module as an example to introduce the typical techniques in the Android platform [14]:

1) *Interface design of the* directory keyword *retrieval.* Android platform layout can be implemented in two ways. One is executing the program function to create dynamic interface layouts with the Java programming language.

2) Directory keyword *retrieval layout display*. The compiled resource file, named "R.layout. Pharmacopeia-category", is parsed to display the visual components in the run-time. The part code of Pharmacopeia-Category class for displaying is shown as following:

```
Public void onCreate(Bundle savedInstanceState) {
   super.onCreate(savedInstanceState);
  setContentView(R.layout. Pharmacopeia-category);
 setTitle("Pharmacopeia-category ");……   }
```

3) *Definition of the embedded database access interface.* The system is deployed into the Android mobile device with a CHP database named *pharmsystem*. The *DataProviderClass* has defined the access interface of pharmsystem. Its part code is shown as following:

```
@Override public Cursor query (Uri uri, String[]
projection, String selection, String[] selectionArgs, String
sortOrder){
    SQLiteDatabase db =
        mOpenHelper.getReadableDatabase();
    Cursor c=db.rawQuery(selection, null);   return c;  }
```

4) CHP Embedded database retrieval. Through the database access interface, the users can obtain the CHP information from multi-angle like Dosage, Functions, Concocted, Characters, therapies, and so on. The part code of ListRecipe class for retrieval is shown as following:

```
Cursor cur=
    getContentResolver().query(getIntent().getData(),
        PROJECTION,sql, null, null);
```

5) *Binding of data source.* Adapter can bind the visual component with the embedded data sources, to display the CHP information with flexible patterns. The part code of adapter object is shown as following:

```
SimpleAdapter adapter = new SimpleAdapter
    (this,fillMaps,R.layout.grid_item,from,to);
listView.setAdapter(adapter);
listView.setOnItemClickListener(this);
```

G. The Deployment of Android Application

Before the Android application is to be deployed into a mobile device, the installing file with ".apk" suffix must be signed with a certificate whose private key is held by their developer. And in the stage of deployment or upgrade, the digital signature will be verified.

4. Conclusions

Using the mobile network technology, we developed an Android-based CHP adaptive learning system. Using lightweight embedded database SQLite in Android's own collection, realized in a mobile device features such as browsing, editing, retrieval module. Using the SOAP protocol, the WEB server data synchronized with the Android data.

The implementation of CHP adaptive learning system, provides an available platform for learner to achieve Pharmacopoeia data conveniently. Providing various retrieval methods, learners are able to learn knowledge in his own rhythm and access only the element of data which relates to him. And Pharmacopoeia data are fully shared and used.

Acknowledgment

This research was funded by grants from Traditional Chinese medicine scientific research fund of Jiangxi Provincial Department of health—"Research and Implementation on ontology-based Chinese herbal pharmacology data sharing platform (No. 2013A193)" and Jiangxi University of traditional Chinese medicine science and technology project—"Research and Implementation of pharmacopoeia intelligent learning system based on Ontology (No. 2013ZR0073)". We would like to acknowledge the input of the entire research team, which included Ke Yu, He Yangmin, Jin Guohua and Pen Caiyin in addition to the paper author. We would also like to thank our students and research participants for their generosity in giving their time, words, images and soundscapes to this project.

References

[1] Myung-suk Lee, Yoo-ek Son. A Study of Learning System for Smart Learning using BYOD. SoftTech 2013, ASTL Vol.19, pp. 106-111, 2013.

[2] Android Platform Official Site, <http://www.android.com/>.

[3] Tan Zheng, Xing Jian-kuan, Zheng Xiang, Software Arvhitecture, Zhejiang: Zhejiang University Press, Mar. 2008.

[4] SOAP Definition. http://webdesign.about.com/od/xmlglossary/g/soap-definition.htm

[5] Google Android software stack in brief, <http://fuyichin.blogspot.com/2008/06/google-android-software-stack-in-brief.html>.

[6] Ming-Chiao Chen, Jiann-Liang Chen, Teng-Wen Chang. Android/ OSGi-based vehicular network management system. Computer Communications 34 (2011) 169–183

[7] Open Mobile Alliance Official Site, <http://www.openmobilealliance.org/>.

[8] Po Qi-bai, Chen Zhong-rong, "Construction of Data Collection & Release in Embedded System," Computer Engineering, vol. 33, Aug. 2007, pp. 270-272.

[9] Yin jing-jun, Xie Chang-sheng, Liu Jun, "Design and Implementation of Embedded High Availability Data Management," Application Research of Computers, vol. 24, Apr. 2007, pp. 220-222.

[10] AlShahwan, F., Moessner, K., Carrez, F., Evaluation of Distributed SOAP and RESTful Mobile Web Services. International Journal on Advances in Networks and Services, vol 3 no 3 & 4, year 2010.

[11] http://webdesign.about.com/od/soap/a/what-is-xml-soap.htm

[12] Moessner, K. and AlShahwan, F., "Providing SOAP Web Services and RESTful Web Services from Mobile Hosts," in ICIW 2010 Fifth International Conference on Internet and Web Applications and Services, 2010, Barcelona, pp. 174-179.

[13] Google Inc., The Developer's Guide (Android-sdk-windows-1.5_r2), Feb. 2009.

[14] Mark L. Murphy, "The Busy Coder's Guide to Android Development," United States of America: Commons Ware, LLC., 2008.