

Research and Design of Intelligent Library Management System under Big Data Platform

Ze Chen¹, Yuanjing Zhu^{2,*}, Chun Chen², Xiaolei Zhong³, Rui Qiao⁴

¹Engineering Training Center, Huazhong University of Science and Technology, Wuhan 430074, China

²Yunnan Minzu University, Kunming 650504, China

³Yunnan University Dianchi College, Kunming 650228, China

⁴College of computer science and technology, Wuhan University of Science and Technology, Wuhan 430065, China

*Corresponding author e-mail: 675119252@qq.com

Abstract

In the era of big data, it's the core of the library's high-quality personalized service to dig deep into the library's massive Book information and borrow information and other data resources. This paper analyzes the key technologies and existing problems in the library management system, and proposes the design and solution of the book management system based on data mining technology, selects the association rule algorithm to realize the book recommendation, and clusters the algorithm to realize the useful information acquisition and mining, thereby enhancing the user's Experience, improve the usage rate of book resources. In the end, readers can use library resources and services anytime and anywhere.

Keywords

Intelligent Library Management System, Big Data.

1. Introduction

With the rapid coverage of the Internet, mobile users continuous increase, various types of information are exploding, and the era of big data is coming. Digitalization and intelligence have become a new trend in social development [1-3]. As a platform for serving the public, the library management system has large data scale and high analyzability. The traditional data processing methods and PC equipment can not meet the demand, and the deep data mining will provide users with a better service [4]. It becomes a popular study of scholars to access the book information accurately and efficiently from a large number of information resources in the library and enhance the user experience.

2. Key technologies

2.1 Android technology

The system designed and developed by this project is based on the Android system platform, using Java as the development programming language. Android is a mobile development platform supported by Google and the Open Handset Alliance. At present, the number of alliance members has reached 34, including mobile phone manufacturers, mobile phone chip manufacturers and mobile operators [5]. The fully open source feature not only enables many mobile terminal vendors and developers to join the Android Alliance, but also makes the Android system a dominant player in the global smartphone market. Android supports a variety of wireless network connections, such as 4G, WiFi, Bluetooth, NFC and so on. In these ways, Android phones can easily communicate over the wireless network, accessing the Internet and servers on a variety of networks. At the same time, the Android framework provides HTTP and other communication protocols, making communication between the client and the server simple and efficient.

2.2 Cloud computing data mining technology

Cloud computing is an Internet-based computing method in which shared hardware and software resources and information can be provided to computers and other devices as needed. The "cloud" of cloud computing is the resources on the server cluster existing on the Internet, including hardware resources (such as servers, storage, CPU, etc.) and software resources (for example, application software, integrated development environment, etc.). The local computer only needs to send a demand message via the Internet, and there will be thousands of computers at the remote end to provide you with the resources you need and return the results to the local computer. [6]. Intelligent library management systems require a more thorough perception of massive amounts of data, requiring multi-dimensional integration and analysis of massive amounts of data. More in-depth intelligence requires universal data search and services, and requires potentially useful data from large amounts of data. The basic types of analysis of massive data are correlation analysis, cluster analysis and evolution analysis. These requirements analysis uses data mining techniques.

2.3. SSM architecture technology

SSM architecture technology is a set conception, which is an abbreviation of Spring, SpringMVC and MyBati (ibatis). It is a framework technology suitable for building various large-scale enterprise application systems.

Spring:

Spring is a powerful framework (seven functional modules) that solves many common J2EE development issues. It also provides a unified way to manage the programming interface for injecting business objects. Spring is a lightweight inversion of control (IoC) and aspect-oriented Programming (AOP) container framework.

SpringMVC:

Spring MVC is a flexible MVC (Model View Controller) software development model. Spring MVC is an important part of the Spring framework, especially for the modeling of a single focus and the corresponding role of the entire life cycle.

The general steps of Spring MVC processing HTTP (Hypertext Transfer Protocol) requests is as follows:

When an HTTP request is received, Spring's front controller dispatcher is responsible for distributing the request. First, the HandlerMapping provided by Spring is assigned to a specific controller, and the DispatcherServlet dispatches the request to the SpringController. HandlerMapping is used to complete the mapping between the client request and the controller. The controller is defined in Spring as the Spring -config.xml file.

SpringController handles requests from the DispatcherServlet. Spring's controller is similar to Spring that accepts HttpServletRequest and HttpServletResponse. The controller processes the client request and returns the ModelAndView object to the DispatcherServlet front controller after the controller processes the client request.

Models and views contain models and views. The view logical name returned by the HTTP request will use the view resolver provided by Spring (ViewResoler) to find the view object in the web application, and then the DispatcherServlet will return the result of the view object to the client.

Spring MVC can easily get a variety of support, from the IoC container support di, to Spring AOP (aspect-oriented programming), support for data access layer, transaction management and more. Spring provides good middle-tier support, which is lacking in many web development frameworks.

The process of processing HTTP requests by Spring MVC is shown in Figure 2-1:

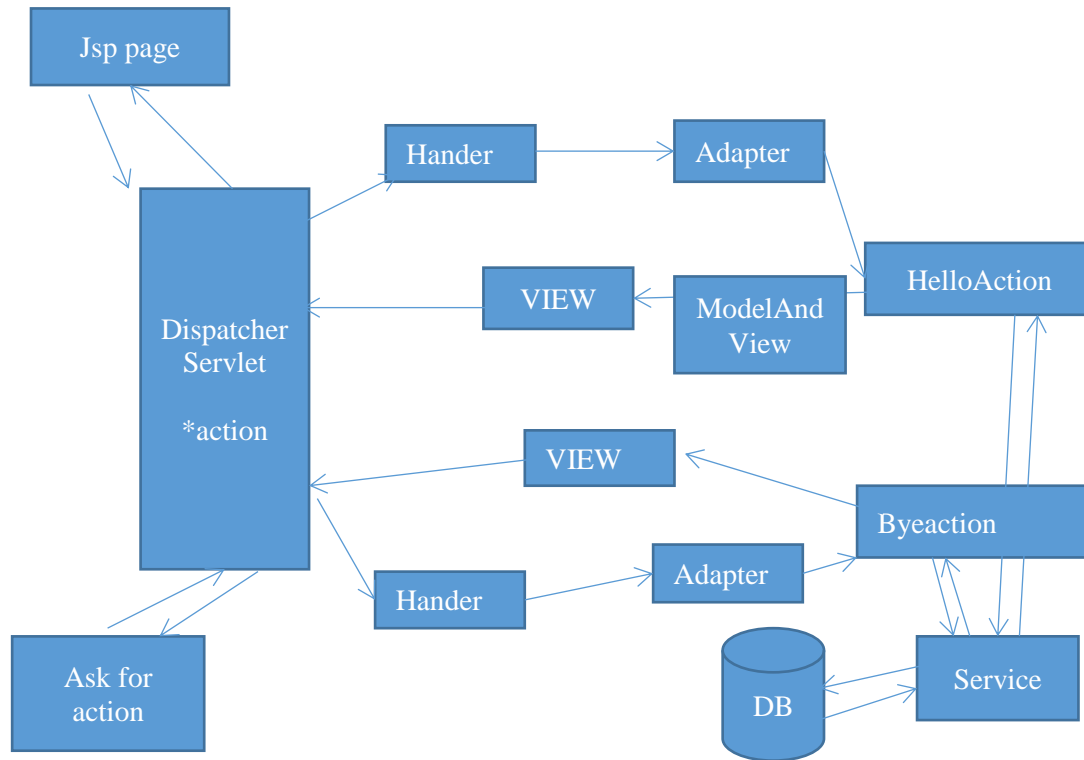


Figure 2-1. Spring MVC processing HTTP request flow chart

MyBatis:

MyBatis is a java-based persistence layer framework. The persistence layer framework provided by iBATIS includes SQL Mapping and Data Access Objects (DAO) MyBatis to eliminate manual settings and result sets for almost all JDBC code and parameters. MyBatis is simple, flexible and easy to use.

3. The overall goal of the system

In the era of big data and information explosion, how mobile Internet users access information in a timely and effective manner has also become a hot research issue. In order to meet people's needs for automation and intelligent, we design an efficient and intelligent library management system and make it a must-have for schools and enterprises. The main concept of this system is intelligent and unmanned operation. The user can use the mobile phone to obtain the informations, such as library book information and personal book borrowing status in anytime and anywhere, which not only facilitates the user but also improves the service efficiency of the library.

3.1 System Architecture

The system is mainly divided into two parts: the mobile phone front-end client and the cloud server. The client is built on the Android mobile phone operating system and its hardware by using C/S design mode. The cloud server is built on the J2EE application server and the Web server and database server by using the B/S design pattern. The system uses the HTTP protocol to realize the connection and data transmission with the remote server program. The system adopts the concept of layered design, abstracts the system out of the presentation layer, the logic layer, the persistence layer, and the communication layer, which can effectively reduce the coupling between modules and clarify the responsibilities of each module, thus enhancing the scalability of the system.

3.2 System design

The library management system software is implemented under the Android system, and the overall structure basically conforms to the MVC mode. MVC is a design pattern that enforces the separation

of application input, processing, and output. The MVC application is divided into three core components: model (M), view (V), controller (C). The application under Android can adopt hierarchical and modular structure design, which is divided into presentation layer, control layer, business layer and data processing. The overall software architecture is shown in the figure below.

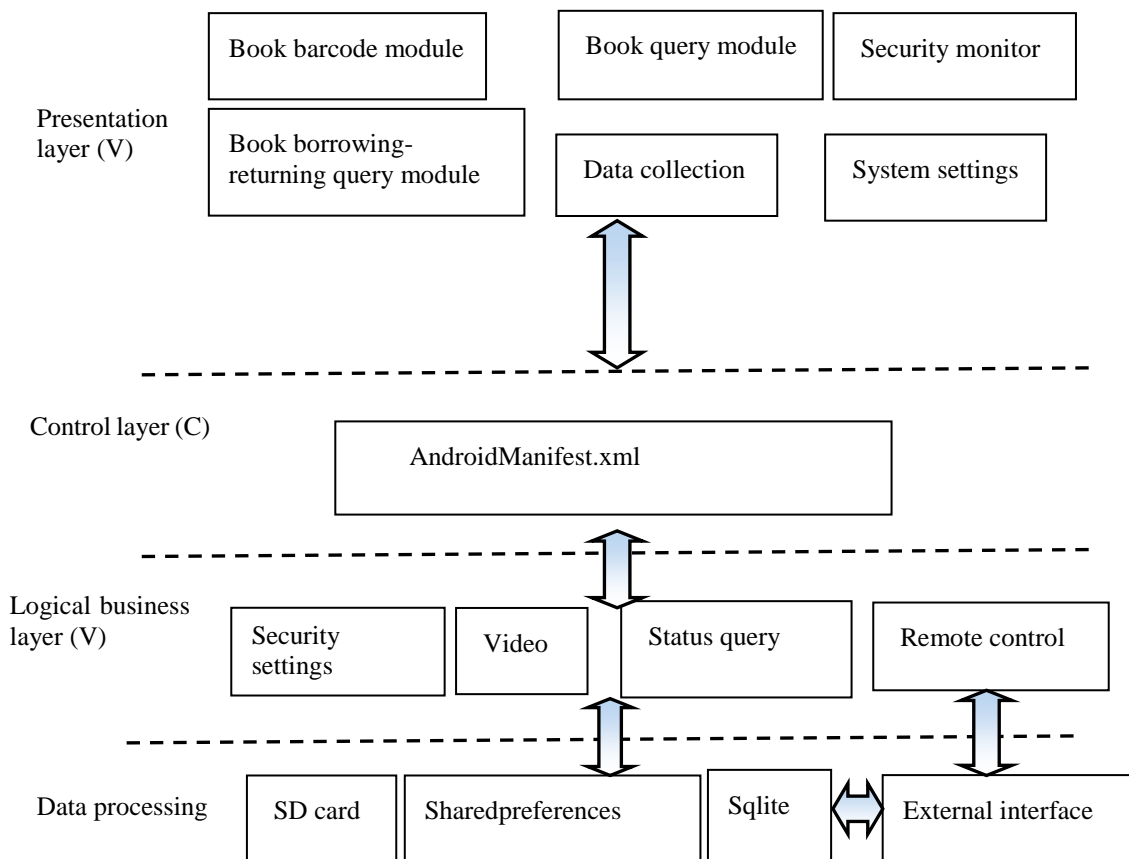


Figure 2. Overall layout of the library management system software

This figure 2 shows the interface of the modules in the library management system. The presentation layer is responsible for presenting graphical operation interface to the users, it displays status information, control information and other information of the model. Each interface of the user operation corresponds to an Activity, and its implementation method is XML layout file generation under layout and hard implementation in the program code.

The control layer is responsible for the flow control between the presentation layer and the business logic layer. In the Android system, it is mainly done by listening to events, jumping between activities, and controlling the information of Androidmanifest.xml.

AndroidManifest.xml is a required file in every Android program. It is located at the root of the entire project and describes the components exposed in the package (activities, services, ContentProviders etc.). It's not only can declare the four components of the program (Avencies, ContentProviders, Services, and Intent Receivers), and also specify permissions and instrumentation (security control and testing).

The business logic layer processes the accepted data accordingly. This is mainly done through the Activity in Android and some classes that are specifically responsible for data processing. The Activity displays the processed results to the user and writes the data that needs to be logged to the appropriate memory.

Data processing operates on Sharedpreferences, database Sqlite, and files. SharedPreferences storage

is used for various states in the system, and data such as videos that require large storage space exists in SD card.

4. System implementation

The project creatively combines the resource information of the traditional library with the mobile phone of the Android system, it designs a mobile library that is convenient to use, convenient to maintain, and versatile, which can greatly facilitate the user to obtain various kinds of book resources in the library. Users only need to log in to the mobile client software and use the client software to connect to the server to realize the borrowing, renewal, and query operations of the book. The system can be applied to all kinds of small and medium-sized libraries. The library's collection resources can be more fully utilized through the mobile library, and the readers can borrow books and provide personalized services. When the readers open the mobile library, they can check the latest books, borrowed books, and payment of liquidated damages.

4.1 Algorithm implementation

Clustering refers to dividing a record in a database into a series of meaningful subsets. Clustering is one of the most important functions of data mining. Clustering is a prerequisite for the concept of deviation analysis and description. This paper is based on the problem of sparse information available to users in mobile learning systems, it clusters users by feature information to discover the target user's neighbor users, and the target user as the computing user set for collaborative filtering by using the desired maximize EM algorithm, because the convergence stability and efficiency of the EM algorithm are better.

4.1.1 Selection of user clustering feature dimensions in library management system

When performing user clustering, the feature dimensions adopted in this paper are age, gender, education level, and occupation. Table 1 is the user clustering dimension data quantification table of the library management system. In each user feature dimension, data preprocessing can effectively improve the user attribute representation ability, and at the same time improve the convergence speed of the algorithm. The user dimension information is extracted from different locations of the database, data is cleaned and quantized, and regularized data is loaded at a specific location of the database.

Table 1. Library Management System User Clustering Dimension Data Quantization Table

Gender	Age	Occupation	Degree of education
	Under 23 years old	Liberal arts and Science university students	Undergraduate, Senior College
	25~30 years old	Liberal arts and Science postgraduate students	PHD, Postgraduate
1 Male	31~40 years old	Institutional staff	Undergraduate
2 Female	40~50 years old	Institution cadre	PHD, Postgraduate
	Over 50 years old	Enterprise employee	Undergraduate, Senior College

4.1.2. Implementation of library management system user clustering EM algorithm

For all user data X of the library management system, it is unclear which cluster group belongs to each other. If the user's complete data is represented by (X, Y), X belongs to the cluster group which is denoted by Y, $Y \in (1, 2, \dots, G)$, the overall data probability density is as follows:

$$f(X, Y; \theta) = \sum_{i=1}^g r_i f_i(X, Y; \theta_i) \tag{1}$$

In the formula: g represents the number of density branches; r_1, r_2, \dots, r_g represents the distribution ratio of each branch point; f_i represents the i -th branch density; θ_i represents the unknown parameter of the corresponding branch; $\{X_1, X_2, \dots, X_n\}$ Represents the user data set in learning system. The EM algorithm is an iterative algorithm. Starting from the initial solution θ_0 , iteratively obtains $\theta_1, \theta_2, \dots, \theta_t$, and the expected value of the complete data log likelihood function is:

$$Q(\theta|\theta_t) = \sum_{i=1}^n E_Y[\log f(X, Y; \theta|X_i, \theta_t)] \quad (2)$$

In the formula, EY represents the expected value of the random variable. The log likelihood function expectation is maximized θ_{t+1} as follows:

$$\theta_{t+1} = \arg \max Q(\theta|\theta_t) \quad (3)$$

4.2 System function module

4.2.1. Search the resource module

Finding resources is the most important and most common part of user functionality, which requires simplicity and efficiency. The user points the camera of the Android platform mobile phone to the bar code part of the book to be inquired, and uses the book bar code module of the Android platform mobile phone software to obtain the book barcode, and uses the book inquiry module of the Android platform mobile phone software to transmit the book barcode to the book management server through the Internet. The information collection module of the library management server software first queries the database module of the book management server software. If the library does not have the book, it searches through the Internet to the online bookstore, and finally returns the library information or the online bookstore search result to the Android platform mobile phone.

4.2.2. Borrowing resource module

The user need to log in to verify your personal information before performing the operation. After the user retrieves and selects the resource, long press to select to perform the operation. The user uses the library borrowing query module of the Android platform mobile phone software, inputs the user name and password, logs into the book management server through the Internet, queries the database module by the database management module of the book management server software, and finally returns the user borrowing information to the Android platform mobile phone.

4.2.3. Book Returning module

The function of adding the returning information is realized, where the returning information is the same as the borrowing information. The key to implement this module is data acquisition technology. The key technologies for data collection are information analysis and reorganization. To obtain the related information of the book corresponding to the barcode from the Internet through the barcode, and it is stored in a database on the server side. When the mobile client sends a request, the server receives the parameters, and then collects relevant book data according to the parameters to the library management database, and reassembles the WAP page to return to the mobile phone.

4.2.4 Resource scoring module

It needs to log in and verify the personal information before performing the operation. The resource score has the same entry and borrowing, but the user needs to select "Score" when selecting a feature. The user's score on the resource is divided into 1 to 5 levels, and comments can be written. It uploads the rating information to the cloud server via java+servlet technology.

5. Conclusion

Based on the Android platform, this paper studies the big data mining technology of mobile learning system. It analyzes the existing problems in the library management system, proposes corresponding countermeasures based on data mining algorithms such as association rules, clustering and

classification, and builds a mobile library management system based on data mining technology to realize book recommendation, book friend recommendation, new book shelf prediction, etc. Finally, it improves the use of book resources and user satisfaction.

6. Project innovation

- 1) Using the scan code function of the mobile phone to obtain the QR code information of the book, and converting the collected two-dimensional code information to complete the operation of the database.
- 2) When the book is queried, the function of voice input is added.
- 3) For users who use the self-service function to borrow books, the user uses the verification code plus the debit card to authenticate the identity when the user picks up the book, so as to ensure the security of the book borrowing.
- 4) Set the trigger button on the corresponding interface of the mobile phone client. When the sub-floor reader picks up the book for a borrower, the button is triggered and the information is synchronized to the mobile phone client of other book-sellers in the same layer to ensure the book is taken. The synchronization of the book is taken by the staff.

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References

- [1] Song Fei. The development and influence of mobile libraries on university campuses [J]. Library Industry, 2011 (6): 13-15.
- [2] Yan Fan. Design and implementation of Android-based mobile library management system [D]: Dissertation. Chengdu: University of Electronic Science and Technology, 2014.
- [3] Yu Xiujing. Research on the Construction of Anhui University Digital Library Alliance Platform Based on Cloud Computing [D]: Dissertation. Hefei: Anhui University, 2013.
- [4] Jin Tao, Zheng Ziwei. FMIPv6 handover algorithm based on Android terminal and data mining[J]. Application Research of Computers,2016(4):1224-1227.
- [5] Yang Lue. Research on personal mobile digital library system based on Android platform [J]. Emotional Exploration, 2012 (6): 98-100.
- [6] Chang Yahong. Research on New Model of Digital Library Service Based on Big Data Mining[J]. Library and Information Guide,2016(7):11-15
- [7] Xiaolei Zhong, Ru Yao, Chun Chen, Yuanjing Zhu. Research on Scalable Zigbee Wireless Sensor Network Expansion Solution[J].IOP Institute of Physics,2018(394/3/032071):1-9.