LIBRARY MANAGEMENT SYSTEM

Feng Hao Yuan, Dalbir Singh A/L Valbir Singh

ABSTRACT: *The library management system is the key management platform for students, teachers, and librarians to query, borrow and return books and manage the information of books and users. This research aims to develop an efficient, fast, user-friendly, and powerful library management system. To achieve this, we have adopted an approach based on the MVC (Model-View-Controller) architecture. In this architecture, servlets serve as the middle layer, connecting requests from a Web browser or other HTTP client to a database or application on an HTTP server. We chose Tomcat as the server platform to support the system's operation. This project introduces an innovative feature: using book cover photos for classification and search. By applying the deep neural network model, the system can help us classify and search books by extracting the features on the book cover. This feature enables users to search for books and related information more conveniently, efficiently, and accurately. The implementation of the system uses Java and Python programming languages. The front-end deployment uses JSP (Java Server Pages) technology to develop a user-friendly interface and improve the user experience. When applying neural network classification technology, the accuracy and stability of the system are our primary concerns to ensure reliable book classification and search functions. At the same time, user privacy and data security issues are fully considered, and corresponding measures are taken to protect the sensitive information of users and libraries. By using the book cover photo search function, we will improve the efficiency and user experience of the book management system. Users can find the books they need more quickly and get detailed book information. This innovative feature provides users with a better book management experience. These improvements will provide valuable ideas for the development and improvement of library management systems and provide a practical case for researchers in information science and library science. The results of this study are expected to provide new ideas and methods for the automation and intelligence of library systems.*

Keywords: Javaweb; Classification; MVC.

INTRODUCTION

With the rapid development of technology, all aspects, including books and library management, have been innovated. There are many papers have proposed the realization and importance of the library management system, such as using the characteristics of Web services, through the network to provide library management functions. It focuses on key aspects such as system architecture design, functional module division, data storage and management, and has demonstrated obvious advantages through experiments [1]. In terms of algorithms, there are many previous efforts such as the book recommendation management system based on the improved Apriori algorithm. The algorithm can recommend books based on the user's history and preferences [2], and the book recommendation system based on the collaborative filtering algorithm. The algorithm can recommend books based on the user's history and preferences [3]. The focus of this tech report is to develop a Java-based book management system and has the innovative function of using photos to identify books. The main goal of this study was to create an efficient and user-friendly system to streamline the library management process and enhance the overall library experience. Our system is designed to serve two different user roles: user and administrator. Users can browse the extensive library collection, get detailed information about each book, and borrow or reserve books. Administrators have additional functions, such as managing the library's inventory, adding new books, updating the book

information, and handling user accounts. An outstanding feature of our system is the integrated photo function for book recognition. Users can easily take photos of book covers from a smartphone or other device with a camera. The system uses advanced image processing algorithms to identify and match the captured images with the corresponding book records in the database. This innovative approach greatly simplifies the book search process and enhances the user experience by providing a more interactive and intuitive interface. By implementing this Java-based book management system, we aim to solve the challenges faced by traditional library systems, such as manual book search and tedious administrative tasks. Our system not only improves the efficiency of library management, but also provides a seamless and convenient experience for users and administrators. In summary, this paper introduces the development of a Java-based book management system, which integrates advanced book identification technology. By combining efficient library management features with ease of taking photos, our system provides a more optimized experience for users and administrators. The system's efficiency and user-friendly interface helps advance library management practices and paves the way for future innovation in the field.

RELATED WORKS

A. Introduction

The dissemination of knowledge plays an important role in the development of human society, and the continuous development of society and the arrival of the new media era have greatly changed and enriched the traditional means and methods of knowledge dissemination. As a scientific, cultural, educational, and scientific research institution specialized in collecting, arranging, preserving, disseminating, and providing documents, the library has played a very important role in knowledge acquisition and dissemination since ancient times. This chapter mainly uses some literature to illustrate the role of the library management system and a summary of related papers on image text recognition.

B. Background

The library management system can measure various operating conditions of the national economy and enterprises; use past data to predict the future; start from the overall situation of the enterprise to assist enterprises in making management decisions; use information to control the behavior of enterprises; help enterprises realize its planning goals. The library management system combines the knowledge of management science, system science, operations research, statistics, computer science and other disciplines. The three elements of the library management system can be described in a popular and simplified way: system viewpoint, mathematical method and computer application. The conceptual structure of the library management system is mainly composed of four parts, namely, information sources, information processors, information users, and information managers.

If we try to trace the history of library management systems. Koha is recognized as the first open-source library automation management system. In 1999, the Horowhenua Library Trust (HLT) library alliance in New Zealand needed a library integration management system that was both cheap and able to meet the needs, but there was no suitable commercial product on the market, so they chose the open-source path and entrusted Katipo Communications Develop a web-based ILS

and name the software Koha. On January 1, 2000, Koha was officially used in the HLT Alliance, and the system code was published on the Internet in the form of open source.

C. neural network model

The application of neural network in image classification has been widely studied and concerned.

AlexNet is a deep convolutional neural network model proposed by Alex Krizhevsky et al. in 2012. It is the first deep-learning model to achieve breakthrough results on the ImageNet dataset. AlexNet's network architecture comprises five convolutional layers and three fully connected layers. It employs techniques such as ReLU activation functions, local response normalization, and Dropout to reduce overfitting and use GPUs for efficient training. AlexNet's success demonstrates the potential of deep neural networks in image classification tasks and lays the foundation for subsequent deep learning research.

VGGNet is a deep convolutional neural network model proposed by Karen Simonyan and Andrew Zisserman in 2014. The main feature of VGGNet is to increase the number of network layers to 16 or 19, using a relatively small 3x3 convolution kernel, so that the network has a smaller receptive field and more non-linear layers. VGGNet's simple and effective design structure makes it easy to understand and implement and performs excellently in many image classification tasks. The success of VGGNet shows that increasing network depth is vital for improving classification performance.

GoogLeNet is a deep convolutional neural network architecture proposed by the Google team in 2014. Its core idea is the introduction of the "Inception" module, which consists of convolution operations and pooling operations at different scales, allowing the network to capture image features at different scales simultaneously. GoogLeNet's network structure is intense, but it successfully solves the computation and storage problems in deep network training through good design and parameter sharing. GoogLeNet's design ideas provide essential inspiration for the subsequent network architecture.

ResNet is a deep residual network structure proposed by Kaiming He et al. in 2015. ResNet solves the problem of gradient disappearance and gradient explosion during deep network training by introducing residual connection. Residual connections pass information through direct connections across layers, allowing the network to learn residual mappings. This structure allows ResNet to build deep networks, such as RESNET-50, ResNET-101, and ResNET-152. ResNet has achieved state-of-the-art performance in many image classification tasks and has profoundly impacted deep learning research.

Inception-v3 is a convolutional neural network architecture proposed by Christian Szegedy et al. in 2015. It is a further improved version of GoogLeNet that improves the classification accuracy and computational efficiency of the network by increasing the depth and width of the Inception module and introducing techniques such as auxiliary classifiers and batch normalization. Inception-v3 has excelled in various image classification tasks and challenges and provides an essential reference for research in image classification.

DenseNet is a densely connected network architecture proposed by Gao Huang et al. in 2016. In DenseNet, each layer is connected to all previous layers, forming a dense connection pattern. This connection gives the network have better ability for information transfer and feature reuse and reduces the problem of gradient disappearance. The core idea of DenseNet is to improve the network's parameter efficiency and model performance through dense connectivity. DenseNet has

achieved good results in image classification tasks and has certain advantages in parameter efficiency.

METHODS

The methodology adopted in this project is based on Java Web technology, utilizing various components and design patterns to implement the desired functionalities. In this project, we mainly divide into two parts, namely, java-web based system and AI model.

A. Java-web based system

a) Java Web Components

The project leverages JSP (JavaServer Pages) as a Servlet, allowing the embedding of Java code within HTML pages. By parsing and compiling JSP into servlets on the server side, the Servlet container processes the requests and generates responses. This separation of logic and structure enables JSPs to serve as the user interface for Java Web applications.

b) Servlets

Servlets are core components responsible for processing HTTP requests initiated by clients and generating corresponding responses. Through servlets, the project can receive request parameters, manipulate request data, interact with the database, and generate various response data types such as HTML, XML, JSON, etc.

c) Java Beans

Java Bean components are utilized to encapsulate data and provide methods for accessing and manipulating it, including getters and setters. As representations of data entities, Java Beans facilitate data transfer between different levels of the application.

d) DAO (Data Access Object) Design Pattern

To achieve the separation of data persistence and business logic, the project adopts the DAO design pattern. The DAO layer communicates with the database and provides methods for adding, deleting, modifying, and querying (CRUD) data. By utilizing DAOs, servlets in the business logic layer can manipulate data at a higher level of abstraction.

e) Encoding Conversion and Filter

To address encoding conversion issues, the project employs the Filter component. Filters play a crucial role in the project by performing request filtering and authentication, ensuring the security and reliability of the system.

f) JDBC Technology

The connection and interaction between the Java application and the MySQL database are established using JDBC (Java Database Connectivity) technology. JDBC allows for efficient communication with the database, enabling seamless integration between the Java application and the underlying data storage.

The above methodology provides an overview of the technologies, components, and design patterns employed in the project. It highlights the use of JSP, Servlets, Java Beans, DAO, Filters and JDBC technology to realize the desired functionalities and achieve the project's objectives.

B. Integration of AI Model

First, we show the process of making the dataset. Throughout the project, we created our own data sets and labels to help us train the model.

In the image search function, data sets play a key role. We collected many book images and associated them with the corresponding tags. These labels are used to represent a category or feature of a book. By using these labels, we can train the model to understand and recognize the features of different books.

To train the model, we use a classification algorithm. The algorithm builds a model by learning the book pictures and corresponding labels in the data set to infer the degree of association between the input pictures and the books. During the training process, we use appropriate optimization algorithms and parameter-tuning techniques to ensure that the model achieves high accuracy and performance.

Through this algorithm and data set design, we can realize the book search function based on pictures. Users can input a picture, the system will analyze the picture and extract features, determine the book corresponding to the picture, and help users quickly find the book they need, which greatly improves the efficiency and experience of users.

After preparing the data set, we need to create our model. In the model section, we used InceptionV3 as the backbone. First, we chose it because of its high accuracy: InceptionV3 has high accuracy in image classification and target recognition tasks. It uses multiple parallel convolution operations and convolution kernels of different sizes to capture image features of different scales, to improve the representation and discrimination ability of the model. In addition, it has powerful feature extraction capabilities: InceptionV3 has multiple convolution and pooling layers, allowing the model to efficiently extract features at different levels of the image. Through multi-level feature extraction, InceptionV3 can obtain a richer and more abstract image representation, thereby improving the performance and generalization ability of the model. At the same time, it is highly complex, can save memory and computing time, and is very efficient. Based on Inception, we flatten the extracted features and add two layers of fully connected neural networks so that the output of the network is the number of books, and from the output of the model, we can know which book corresponds to the input picture.

In the training phase, we used the RTX3060 graphics card to train the model and conducted 10 Epochs training. During the training, we set the learning rate is 0.0001.

CONCLUSION

This study focused on the development of a library management system. By utilizing Java Server Pages and MySQL relational database, the system successfully implemented core functionalities and met the requirements of book resource management, reader information management, and loan management. Throughout the project, several notable achievements were realized.

The system effectively addressed the needs of librarians by providing convenient book and reading resource management functions. Librarians could easily add, edit, and delete book information, as

well as record readers' basic information and borrowing history. User experience and interface design were prioritized, ensuring an intuitive and user-friendly interface. Librarians could efficiently perform administrative tasks, while readers could access quick query and operation functions. Moreover, the integration of artificial intelligence technology enhanced the system by enabling book searches through image recognition algorithms. This innovation significantly improved the efficiency and user experience of the library management system, making it easier for users to find the books they need. Overall, the system exhibited comprehensive functionality, a friendly interface, and straightforward operation, providing librarians with a convenient tool for book and reader information management. Additionally, it met the needs of readers by offering quick and convenient borrowing services.

However, some constraints and areas for future improvement were identified. The system's hardware resources had limitations, and traffic load capacity needed enhancement. The speed of deep learning models was relatively slow due to limited CPU and GPU capabilities. In future development, the focus will be on improving traffic load capacity and security. Optimization measures will be implemented to enhance system performance and responsiveness. Strengthening the security mechanism, adopting robust encryption technology, and implementing authentication methods will ensure data security and privacy protection. Furthermore, efforts will be made to refine and enhance the AI model to improve the speed and accuracy of book searches. Parameter reduction and hardware optimization will enable quicker responses to user search queries. Intelligent functions, such as recommendation systems, personalized push notifications, and automated book borrowing and returning processes, will be considered to further enhance user experience and provide accurate services.

In conclusion, continuous improvements and advancements will be made to the library management system. Feedback from users will be taken into account, and ongoing research and innovation will ensure that the system remains at the forefront of book management solutions. The goal is to meet users' evolving needs and establish the system as a leading solution in the field of book management.

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FENG HAO YUAN (A184591)
PROF. MADYA DR. DALBIR SINGH A/L VALBIR SINGH
Fakulti Teknologi & Sains Maklumat,
Universiti Kebangsaan Malaysia