Application of Cloud Computing in Library Information System

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Abstract: In order to understand the application of cloud computing in library information system, an application research based on cloud computing in library information system is put forward. In this paper, firstly, the characteristics of cloud computing are studied, and based on the open source Ubuntu operating system, the IaaS layer and PaaS layer of cloud computing are designed and implemented to build a cloud computing platform. Secondly, a new tool Django is used to design and develop the book information software based on this platform, which can provide book information service based on Web after deployment. The traditional library information system has the defects of repeated construction of resources, weak expansion ability, poor configurability and high cost. The new system is better than the traditional system in information service ability, resource sharing, configurability and scalability. The book information software based on cloud computing Django technology and MVC pattern is fast to develop and easy to modify, which is convenient to dynamically adjust the system functions and service capabilities, and also enhances the expansibility and configurability of the whole system.

Keywords: cloud computing; Books and materials; information system

1 Introduction

Most of the books and reference information systems in use in China are designed in the traditional mode, which has some problems, such as high requirements for software and hardware, weak expansion ability of resource duplication construction system and poor configurability. The library information system based on Cloud Computing can give full play to the characteristics of cloud computing, make overall use of software and hardware resources, and provide powerful information services and resource provision capabilities. The system uses a unified resource list to provide the most reasonable service, which is no longer limited by region and time; The cloud computing platform can dynamically deploy, configure, reconfigure and cancel services as required. For different users, the system can be customized in function rather than code level, without independent deployment, providing flexible customized functions, thus well meeting the service needs of different units and different periods, and easily handling the increase of traffic by expanding resources as needed to support the change and development of units, so as to achieve on-demand use and availability everywhere; In the case of a large increase in the number of users, it is not necessary to change the application architecture, but only to increase the number of hardware devices, which can support the growth of application scale; The powerful function of cloud service can be used to

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process large data sets and make full use of large-scale parallel processing. By deploying multiple computers to form a "cloud" to jointly undertake information services, high-performance servers are no longer required, saving hardware investment. The library information system based on cloud computing is perfectly combined with open source operating system, which saves more capital investment. Cloud computing is the product of the development and integration of traditional computer technology and network technology such as Distributed Computing, Parallel Computing, Grid Computing and Utility Computing. It takes virtual technology as the core and infrastructure as a service, platform as a service and software as a service as the service mode. Its ultimate goal is to provide transparent, convenient and fast application services. Cloud computing has the following advantages in the construction of book resources management: accelerating the integration and sharing of information resources, improving the storage capacity of information resources, improving the reliability of server operation, reducing related costs and improving the utilization rate of library information resources. The concept of low carbon, environmental protection and on-demand service advocated by cloud computing is in line with the development trend of university libraries, and the emergence of various cloud services and cloud terminals has also opened a new door for university book management. Therefore, the combination of book management platform and cloud computing is also of great value for practical application[1-2].As shown in Figure 1:

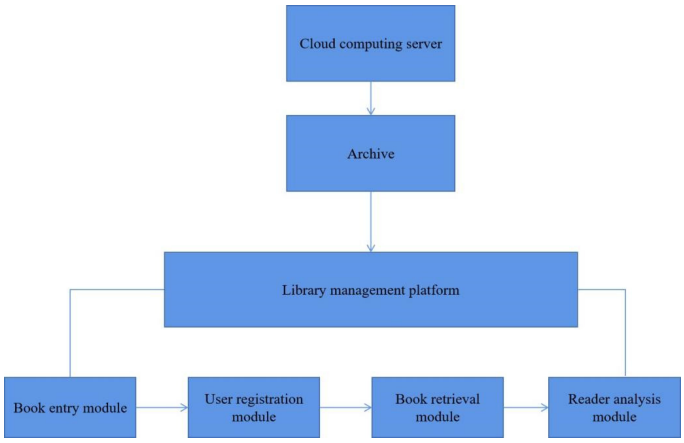

Figure. 1 Cloud computing service platform

2 The overall design of the system

According to the types of services provided by cloud computing, it can be divided into three layers. The lowest layer is called Infrastructure as a Service (IaaS). IaaS integrates memory, 1/O devices, storage and computing power into a virtual resource pool to provide users with needed storage resources and virtualized servers. Above the laaS layer, there is a service-oriented host environment platform customized for specific needs, which is called Platform as a Service(PaaS). PaaS provides services such as development environment, server platform and hardware resources to users, and users can develop programs based on its infrastructure and transmit them to other users through the Internet and its servers. The top

layer provides users with applications they are ready to use, which is called Software as a Service (SaaS). Layers in cloud computing architecture can be divided, that is, a certain layer can complete a user's request alone without the service and support of other layers.

This research is divided into two parts: First, a variety of cloud computing IaaS software and PaaS software are analyzed and selected, and IaaS and PaaS are deployed on Ubuntu operating system to achieve seamless integration and stable operation, and build a new cloud computing platform. Secondly, on the cloud computing platform, the information data is modeled, and the database supporting the cloud computing platform, such as Google Dalastore of Ap-pScale, is adopted. Using Django, a new development tool, and Web service technology, a Web-based library information software is designed and implemented. The software provides an open service extension interface, which can flexibly expand business functions without changing the system architecture. Finally, this set of books and information software is deployed on the built cloud computing platform, and services are provided to users in a standard Web way to complete the construction of the whole system[3-4].

2.1 IaaS layer design

The advantage of IaaS is that users only need low-cost hardware and rent corresponding computing power and storage capacity as needed, which greatly reduces the cost of users on hardware. IaaS supports many applications through virtual machines, and it can be used to deploy applications to many ordinary computers, thus avoiding the purchase of expensive high-performance servers. Eucalyptus is the implementation of Amazon EC2, which takes scalability as the main design goal, provides free use in the form of source code, can be installed on Ubuntu operating system, has perfect technical support, and is a good choice for realizing IaaS of cloud computing.

The main components of Eucalyptus include NodeController, Cluster Controller and Cloud Controller.

The node controller is responsible for managing a physical node. A typical Eucalyptus is equipped with multiple node controllers, and a node controller can manage multiple virtual machine instances running on the node. Only one node controller needs to run on a machine, which is responsible for the operation, description and termination of the instance, and calls the management program to control and monitor the running instance.

The Web service technology used by Eucalyptus has a simple organizational structure, modular design and convenient expansion. Its architecture is shown in Table 1. A relatively complete installation and configuration of Eucalyptus requires at least four machines: two as node installation instance managers, one as cluster controller and one as cloud controller. Multiple ordinary microcomputers can be deployed as node controllers, and various instances can be run on them to form a specific cloud. Moreover, the node controllers can be flexibly expanded when necessary to give full play to the advantages of cloud computing. The cluster controller is managed through the cloud controller, and the client accesses the instances in the node through the cloud controller[5].

Table 1. Hierarchical Topology of Eucalyptus

Cluster Controller	NodeController	Cloud Controller
Web service technology	client	Cloud computing

2.2 PaaS layer design

The software selection of PaaS layer should comprehensively consider the stability, cost performance, bandwidth, platform scalability, manageability and portability. AppScale is the implementation of the API set of Google App Engine, which provides a platform-as-a-service cloud computing infrastructure, so that end users can not only deploy, test, debug, measure and monitor Google App Engine applications, but also facilitate the expansion of PaaS. AppScale provides a good choice for the localization of cloud computing services, allowing users to run AppEngine applications using their own computer clusters, and can run transparently on laaS, especially on Ubuntu and l Eucalyplus, which provides a good foundation for the design of our cloud computing platform.

When the App Engine application is executed in AppScale, multiple components of Ap-pScale can be automatically deployed, managed, scaled and fault-tolerant, which reflects the advantages of cloud computing. AppScale has four components, among which AppServer is the main component for executing Google App Engine applications. Each AppServer can only execute one application at the same time, but multiple AppServers can be added to meet the needs of the host for executing multiple applications. The AppLoadBalancer is responsible for handling the user's first request. After the user successfully logs in, this component allocates the route for the user's request and finds a suitable AppServer, and the AppServer handles the request for application control. After that, other requests of this user will be directly routed to this selected AppServer, and there is no need for the AppLoad-Balancer to redistribute the route. Database Master is the main interface of data storage, which provides access to the data storage implementations available for AppScale. And one or more Database Slaves, together with Data-base Master, provide distributed, scalable and fault-tolerant data management capabilities.

As shown in Table 2, each component communicates with each other by using AppController, which installs, initializes and dismantles all AppScale instances in the deployment environment, and is also responsible for the deployment and authentication of Google App En-gine applications. Users of Google App Engine application interface use SSL to contact AppServer, and the first login request to AppScale environment is always handled by AppLoadBalancer, and then routed to the appropriate application server Ap-pServerl after successful login. Developers use the AppScale toolset to create applications that can be accessed by users. The functions provided by these toolsets can create AppScale instances and deploy App Engine to AppScale[6-7].

Table 2 Application Structure of AppScale

Database Slaves	Data-base Master	App Controller
APPController	APP Load Balancer	App Scale Tools

3 Design and Implementation of Library Information Software Based on Django

Before the formal development of the system, it is necessary to analyze the business process of the universally applicable library information software, and the user unit will provide the

business process and related operating specifications to analyze the specific information and data together. According to the analysis results, the standardized modeling and description of business processes are carried out, which provides the premise and basis for the implementation of integrated software design and development based on services and Web technology.

A new tool, Django, is used to develop software. This tool provides an open service extension interface by using Web service technology, which can flexibly expand business functions without changing the system architecture. It also has the advantages of separating data model, control and view, which is fast to develop and convenient to modify. There are four Python files in Django, which are models.py, views.py ,urls.py and l html template files. They are responsible for the model, view, control and template of the system, and the mode they follow is called "Model-View-Controller" (MVC). The advantage of this design pattern is that various components are loosely combined, and each Web application developed by Django has a clear purpose and can be changed independently without affecting other parts.

First, create the Models.py file, which mainly uses a Py-thon class to describe the data table, called model. With this class, you can create, retrieve, update and delete records in the database through simple Python code without writing SQL statements[8]. The code is as follows:

from django.db import models

class Goods(models.Model):

name=models.CharField(max_length=50)

pub_date=models.DateField

Then create the Views.py file, which contains the business logic of the page. The function (that is, latest_goods) inside is called view, which prompts the template file (here, latest_goods.html) used for the data of this function. The code is as follows:

from django.shortcuts import render_to_responsefrom models import Goods

def latest_goods(request):

goods_list=Goods.objects.order_by('-pub_date)

Then create a urls.py file, which indicates which view each URL calls, and acts as a Controller. The code is as follows:

from django.conf.urls.defaults import*import views

urlpatterns=patterns

The last work is to write html templates, there can be multiple template files, and it uses the template language with basic logic statements to design the display format of data on the page.

After the software is written by Django, it will be released on the deployed cloud computing platform, and it can be used by using an ordinary browser to enter the URL on the client[9-10].

4 Conclusion

The library information system based on cloud computing has the advantages of both IaaS and PaaS, which can use multiple ordinary computers to form a "cloud" instead of a high-performance server, saving hardware investment; The software part can be customized in function rather than code level, and can be dynamically deployed, configured, reconfigured and cancelled as needed; It has good scalability and can easily handle the increase of network traffic and users by expanding software and hardware resources as needed; The library information software based on Django technology and MVC pattern is fast to develop and easy to modify, which is convenient to dynamically adjust the system functions and service capabilities, and also enhances the expansibility and configurability of the whole system.

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