Design and Implementation of Agro-technical Extension Information System Based on Cloud Storage

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Abstract. In order to solve the problems of low efficiency and backward methods in the agro-technical extension activities, this paper designed an agro-technical extension information system based on cloud storage technology. This paper studied the key technologies, such as cloud storage service engine, cloud storage management node and cloud storage data node and designed the overall architecture of the agro-technical extension information system based on cloud storage technology. The application results demonstrate that this system has significantly improved the agro-technical extension service levels and cloud storage can greatly improve data storage capacity of the agricultural extension information system.

Keywords: cloud storage; agro-technical extension; information system

1 Introduction

Under the condition of much people in little land and the shortage of land resource, the fundamental way to ensure national food security is how to convert the achievements in scientific research into productive forces and the key lies in how to innovative grass-root agro-technical extension. Currently, the main problems in grass-root agro-technical extension system are as follows [1]: First, the means and methods of agricultural extension need innovation urgently, "one mouth with two legs" promotion model is still the mainstream; Second, the management of agro-technical extension needs to be improved, how to evaluate the effectiveness of the extension is also very difficult; Third, technicians need to raise their quality and ability, overall aging, outdated knowledge, single profession are big problems among the technicians, they need to raise their quality and ability immediately.

The agro-technical extension information service system based on modern information technology, providing agro-technical consulting, expert consultation, training services, extension logs, dynamic scheduling and other functions, can effectively solve the problems which farmers encountered during the agriculture production and management activity[1]. However, the amount of user data in the agro-technical extension information system is large with a rapid data growth.

The traditional storage solutions on mass data storage and resources dynamically expanding have certain difficulties.

Cloud storage, which is based on virtualization, distributed, clustering technology, provides consistent access to data storage and business functions through unified management and scheduling over the various types of network storage devices[2]. Generally speaking, cloud storage has the following characteristics [3]: more storage space, better scalability, higher performance, and massive concurrent access.

In order to satisfy the requirements of massive data in the agro-technical extension information system, this paper introduced cloud storage and studied the key technologies of cloud storage, such as cloud storage service engine, cloud storage management node and cloud storage data nodes. Finally, this paper designed and realized agro-technical extension information system based on cloud storage.

2 Previous Work

The studies [4] on agricultural extension informatization were started early in our country, many of them focused on the collection or storage of the agro-technical extension resources. To achieve adequate information sharing, somebody [5] built a unified platform to collect information about agro-technical extension with the help of modern information technology. To provide better services for the agricultural extension workers, somebody [6] built a database about practical agricultural techniques with a large capacity. In 2009, Agricultural Information Institute [7] of CAAS carried out the research on agricultural extension informatization based on 3G technology and established a national information platform for grassroots agricultural extension. The use of cloud computing technology to solve the problems of agricultural extension informatization is still relatively rare.

3 Key Technologies

3.1 Service Engine

Cloud storage service engine [8] is the power unit of cloud storage system, providing the underlying support for the service node. It got the metadata information of data's specific location from the cloud storage management node, then directly read data from the storage node through the data transmission channel. The service engine meets the response speed of data processing and can quickly locate the target data nodes as index is supported by the cloud storage management nodes. Cloud storage service engine is the hub of the entire cloud storage system and needs to configure high-performance hardware.

Cloud storage service engine provides services such as resource management, object storage, database, etc. The support of concurrent access to multiple services is achieved through the expansion of service engine nodes.

3.2 Management Nodes

Cloud storage management node [8] is responsible for the management and monitoring of storage resource in the entire system, including metadata management, storage node failure handling, data redundancy, real-time data migration, etc. To schedule and manage easily, cloud storage management node will regularly collect data information from the data nodes, then reports the data storage location information to the service engine.

Cloud storage management node provides services such as metadata management, domain management, table space management, etc. It is responsible for the resource allocation, resource monitor and the automatic discovery and deployment of domain.

3.3 Data Nodes

Cloud storage data node [4] is the main component of cloud storage system and is responsible for data storage on its own node. Under the scheduling of the management node, data node implements cross-node data redundant and data recovery and provides storage resources to the entire system supporting the business system.

Cloud storage data nodes can startup, initialize and shutdown; supporting various fault alarm; supporting data query, insert, and delete; supporting synchronization of data copies, data recovery; copies statistics of resources and so on.

4 System Design

The entire system consists of the application layer, the interface layer and the storage layer [9]. Application layer is geared to the needs of grass-root agricultural technician by providing logs, video, voice, conferencing and other information services; Interface layer provides the interfaces to access the underlying storage resources, such as containers interfaces, directories interfaces, files interfaces and so on; Storage layer provides virtualized storage resources services to the application layer through cloud storage service engine, cloud storage management node and cloud storage data node.

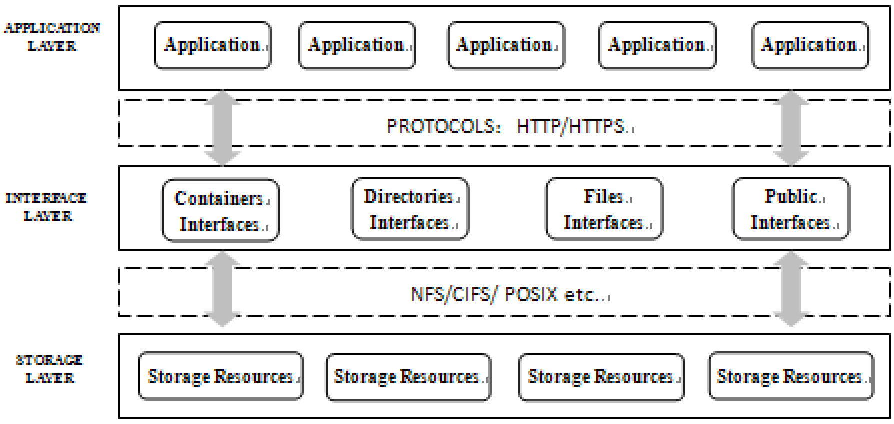

Figure. 1. Architecture of System

4.1 Application Layer

(1)Design of Service System

To realize the functions of information exchanges, knowledge sharing and other business services, service system takes the grass-root agricultural technician as the core, focusing on active participation, self-learning, independent innovation. It includes the following subsystems: micro-blog communication subsystem, agro-technical blog subsystem, interest communication subsystem, remote video diagnostic consultation subsystem, on-demand courseware subsystem, agro-technical network library subsystem, diagnose prescription subsystem and so on.

(2)Design of Management System

Management system used WEBGIS technologies to position agricultural technician, providing management and performance appraisal to agricultural technician and agricultural experts. It includes the following subsystems: agricultural technician management subsystem, agricultural technician work load statistics subsystem, agricultural expert management subsystem, agricultural technician performance management subsystem and so on.

(3)Design of Information Collection System

Information collection system directionally gathers specific agricultural situation information focused on different times and different regions, such as the coverage of crop, the situation of crop pests and animal diseases, the market supply and demand of agriculture products and materials etc. It includes the following subsystems: macro data acquisition subsystem, agriculture emergencies acquisition subsystem, significant agricultural situation directional collection subsystem, agricultural products marketing information acquisition subsystem, networking terminal acquisition subsystem and so on.

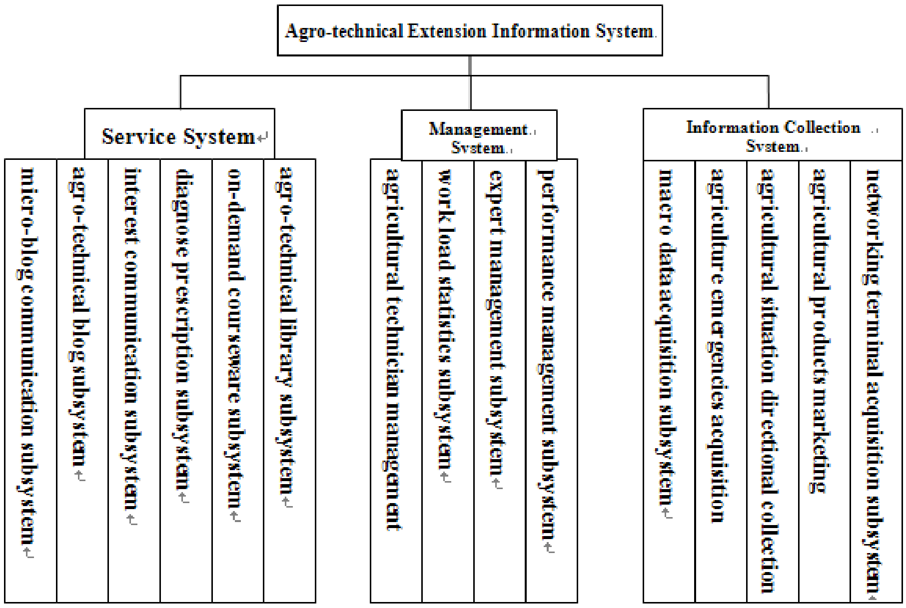

Figure. 2. Structure of Business Functions

4.2 Interface Layer

Interface layer provides object storage services for the application layer through load balancing and web services, such as REST (Representational State Transfer) access interface. The interface to request resource service is divided into four categories based on the operating resources.

Container: Container consists of container name, container properties, metadata, storage policy and ACL (access control list). Containers are virtual carriers of storage objects in the directory service system and it virtually divides up the entire directory space. Name is the unique identity for a container. Each container can set metadata, ACL and storage strategy.

Directory: Each directory can be viewed as an object in the container, directory path information is identified by object URI (Universal Resource Identifier) tag. Directory is comprised of attribute, metadata, access control lists.

File: In the container, each file can be viewed as an object and the location information can be identified by the object identifier URI tag. File is also comprised of file attributes, metadata, access control lists and entity data.

Public class: public class interface focused on the common characteristics of containers, directories and files, such as setting of user-defined metadata over file / directory; access of user-defined metadata over files / directory; obtain of the attributes about file / directory; search of file / directory; browse of the recycle bin; restore of the recycle bin; delete / empty of the recycle bin.

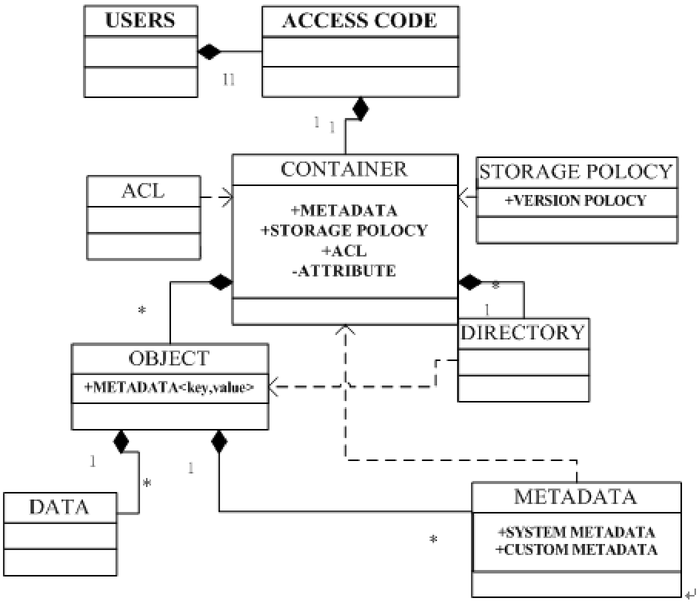

Figure. 3. Model of Interface

4.3 Storage Layer

Storage layer uses two differential pairs to transfer management data and user data, adapted master-slave mode. Cloud storage service engine called management data from cloud storage management node to access and control the data nodes directly; cloud storage management node manages the data nodes through the metadata.

Cloud storage service engine utilizes metadata information of specific data storage location providing by cloud storage management system, then interact directly with the storage nodes through the data transmission channel to read and write data. Cloud storage service engine provides data object access interface, such as containers, directories, files, and so on. It satisfies data storage needs for the videos, images, documents in the application layer.

Cloud storage management system periodically collects status data, resources data from data node. With the help of metadata nodes, it has a unified management to all data nodes, then reports the information, such as the physical location of the node, the available space, to the cloud storage service engine real-time. The support to index in the cloud storage management system can help cloud storage service engine quickly locate the target data nodes and meet the response speed of data processing.

Distributed file system is installed in the data nodes to virtualize physical storage resources to unified logical storage resources. Data nodes provide logical storage resources to the cloud storage service engine and report the corresponding relationship of the physical and logical storage resources to the cloud storage management node. Data is stored on the nodes as objects. After processing with a certain algorithm, data is distributed to many nodes and this increase system reliability and load balancing capabilities. Data nodes also support the expansion of storage nodes and redundancy.

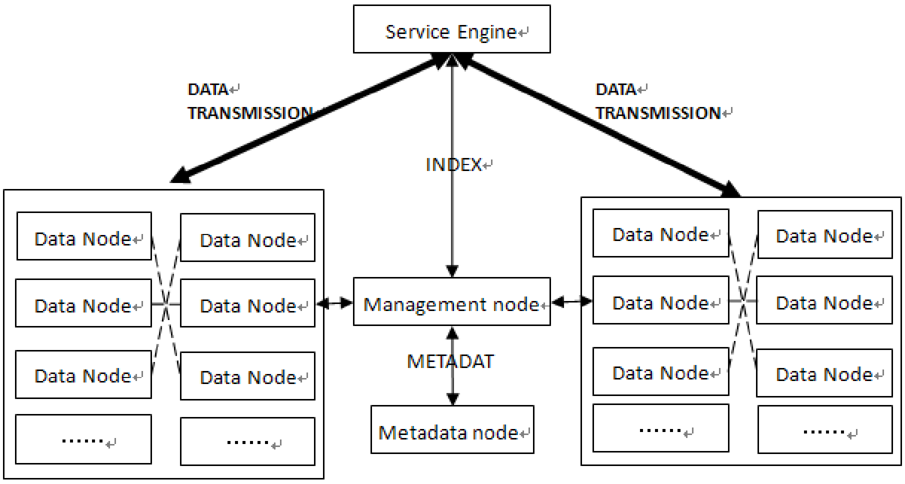

Figure. 4. Architecture of Cloud Storage

5 Implementation

Application layer system employs Struts2 + Spring + Hibernate framework and is divided into the presentation layer, business logic layer, data access layer. It includes functional modules, such as agricultural advice, diagnosis prescription, marketing logs, promotion maps, expert consultation, exchange of experiences, training courseware, agricultural information gathering, disaster submit etc. Cloud storage resources includes four cloud storage service engines, one cloud storage management node, two data nodes, two metadata nodes. With a mechanism of multiple data copies, cloud storage resources provide a total storage capacity of 50T.

Figure. 5. Home Page of Agro-technical Extension System

Agro-technical knowledge module provides agricultural technology about planting, breeding, production and processing etc. It has more than 100,000 data records.

Figure. 6. Module of Agro-technical Knowledge

Agricultural video module provides videos, courseware concerning field crops, livestock, disease prevention, aquaculture, fruit growing, vegetable growing, fish processing and so on, the number of videos in the current system is over 5000.

Figure. 7. Module of Agricultural Video

Currently, focused on the grass-root agricultural technician, the application and demonstration of this system has been carried out in Miyun, Daxing Beijing, Xinghua Jiangsu, Luohe Henan and other places. This system has greatly improved the extension capacity and service level of the agricultural technician and brought a good demonstration effect.

6 Conclusions

Fewer resources and lower efficiency are big problems in the agro-technical extension information system. To meet the requirements of mass data storage, dynamic expansion, resource conservation in the agro-technical extension information system, this paper introduced cloud storage technology to store data. Cloud storage is a scalable, highly reliable storage mode, supporting mass data storage and resource dynamic expansion.

From the adoption of cloud storage technology, the following conclusions can be drawn: 1) Data storage capacity of business systems can be greatly improved; 2) Since multiple copies of data store, data security is guaranteed; 3) The stability of the system is improved as the interface layer is adopted.

Acknowledgment

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