Design of intelligent human resource management system based on cloud computing platform

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Abstract: Human resource management is the core of any company's management. The Human Resources Management System (HRMS) has become the core of the company's management information system. Therefore, it is inevitable to design and implement the HRMS on a cloud platform. This article refers to a large number of domestic and foreign literature on cloud computing and HRMS, and carefully studies cloud computing platforms and similar management information systems. The aim is to solve the problem of mutual independence of some enterprise management information systems and excessive redundancy of HR information, integrate all the information systems that require employee information and employee login, eliminate the redundancy of basic employee information in the existing management information system, achieve real-time synchronization of information, achieve single sign-on, and improve the usability of the system.

1. Introduction

With the rapid advancement of technology, especially in recent years with parallel networking technology, software technology, and computing technology, the emergence of cloud computing technology has become inevitable [1]. Initially, people were not satisfied with the rate of CPU Moore's Law growth and connected many computers in parallel to achieve faster computing speeds, which is known as parallel computing [2]. Cloud computing is a subscription-based and pay-as-you-go service, where people only request computing and other services from service providers when they actually need them, and release the resources immediately after use, which are then reallocated to other subscribers by the service provider. This model greatly improves resource utilization.

The aim of this thesis is to design and develop a personnel management system within a human resource management system based on cloud computing platforms. This is not just a regular personnel information management system, but based on the actual needs of service enterprises, it requires a personnel information management system that can integrate almost all other management information systems' basic employee information. Enterprises need it to provide a perfect external interface for other human resource subsidiary systems and other systems within the enterprise. Since the human resource management system involves sensitive personal information and is developed and designed based on cloud computing platforms, information security is an important topic. Therefore, this thesis will focus on the construction of the human resource management system and system information security.

2. Overall design

Human resource management system is aimed at assisting enterprise human resource management, with employee basic information management and resume management as the core, to help the enterprise develop quickly. Based on the needs analysis, we conclude that the human resource management system consists of employee basic information management, employee resume management, department management, position management, duty management, department head management, user login function, access control function, and other functional modules[3].

The human resource management system uses Windows Azure cloud service as the operating platform. The entire system is developed in Web Service mode, that is, B/S mode. The cloud service belongs to the platform as a service (PaaS) type. The architecture of the system is shown in Figure 1. In the development process, we only need to focus on our own application programs and data, and the platform supplier manages everything else.
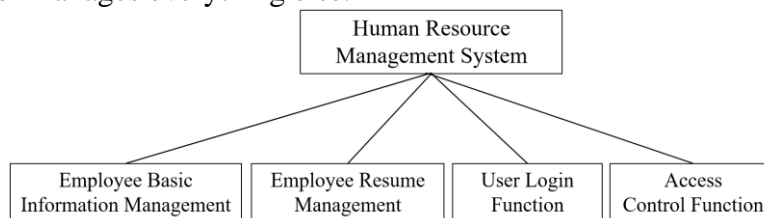

Figure 1: System Function Structure Diagram

3. Functional module design

According to the overall design, the human resource management system consists of employee basic information management, employee resume management, department head management, duty management, level management, trust service, and delegation management.

3.1 Employee basic information management

Employee basic information management should be divided into two parts. One part is the attribute that employees can freely modify, and the other part is the attribute that employees cannot modify, such as ID card information or household registration information, name, email, etc. For modifiable attributes, such as landline, mobile phone, IM communication tools, etc., employees can freely modify them. The attribute that employees cannot modify is not really unmodifiable, but after submission, it needs to be confirmed [4].

When a new employee joins the company, the head of the human resources department is responsible for creating a basic user profile for the new employee based on the basic information provided by the employee, such as identification documents (ID card or household registration), etc. Once completed, the employee can log into the system to continue entering additional employee information, such as contact information, emergency contacts, bank card information, and employee ID card photos. For employees with regular authorization requirements, they can only update their own contact information here. When the update is successful and submitted, the workflow will be directed to colleagues in the human resources department. After confirmation by the human resources colleagues, the system will finally display the contact information and basic information. At the same time, this module provides the function to query the contact information and level of colleagues in the entire company, as well as the company's organizational structure. For access control in this area, the company believes that all authorized users can only perform read-only

operations, in other words, the contact information of all internal employees of the company can be shared.

3.2 Employee Resume Management

Five working days after the employee formally joins the company and all employee basic information is confirmed, the system automatically sends an email to remind the employee to update their personal resume. The employee needs to add their education, work experience, project experience, etc. and upload scanned copies of documents such as degree certificates, graduation certificates, and award certificates. The information can only be displayed after being reviewed by the head of the company's human resources department [5]. In this module, the user can view their own information, and the company's management can only view the resume information of personnel in their own department. Only the individual has the permission to modify all resume information, even the human resources department manager does not have the right to modify other people's resumes. When an employee updates their resume again, it will still be in the pending confirmation status and will need to be confirmed by colleagues in the human resources department. Colleagues who have not updated their resumes within six months will also receive an email notification to update their resumes. Initially, only the individual can update their own resume. Two days later, if the resume is still not updated, it will be copied to the direct manager. If it is still not updated after two days, it will be copied to the head of the human resources department.
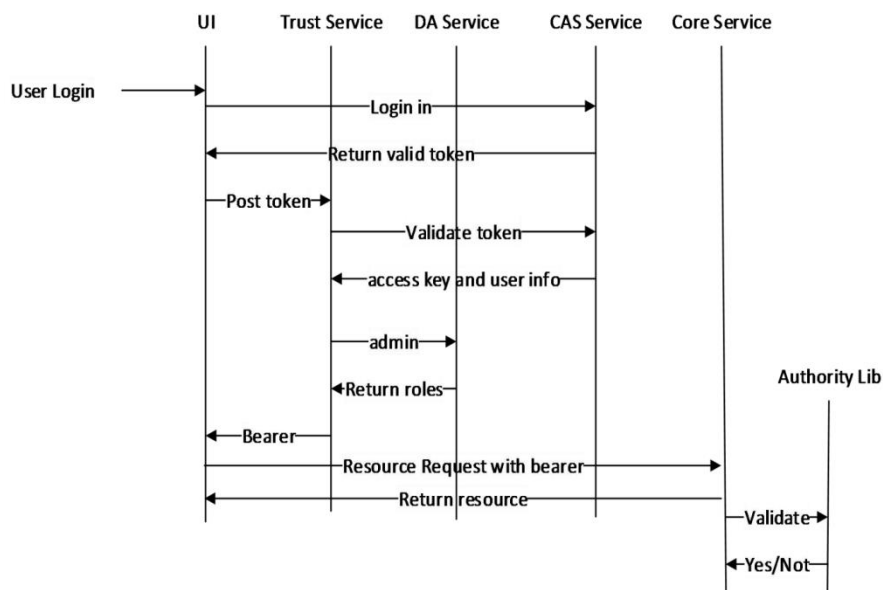
3.3 User login function

Figure 2: Login Timing Diagr

After a new employee joins the company, the head of the human resources department will submit an employee file creation request to the human resources management system. The human resources management system will automatically send the request to the CAS system. CAS will automatically create the user and send a password reset link to the specified email. The information will be sent back to the human resources management system. At this point, the human resources management system will automatically store the employee information in the system. After successful addition, according to the business process design in the requirements, when an employee requests the homepage of the human resources management system, the system will

automatically redirect to the login page of the CAS system. The employee will log in to the human resources management system using the CAS login credentials. After successful CAS verification, the trust service of the human resources management system will use the one-time token returned by CAS to verify and return user ID and other information. The trust service will then query and return the delegated management information to the trust service, and finally generate a Json Web Token. Figure 2 shows the sequence diagram of the user login function.

3.4 Access control function

Role-Based Access Control (RBAC) is an effective way to implement access control for enterprise security policies. The central idea is that various permissions for system operations are not directly granted to specific users, but a role collection is established between the user collection and the permission collection. Each role corresponds to a set of corresponding permissions. Once a user is assigned the appropriate role, the user has all the operational permissions of that role. The benefit of this approach is that there is no need to assign permissions every time a user is created. Only assigning the user the corresponding role is sufficient. Moreover, the user's permission changes are much more frequent than the role's permission changes, which greatly simplifies user permission management and reduces system overhead. Figure 3 shows the RBAC model.
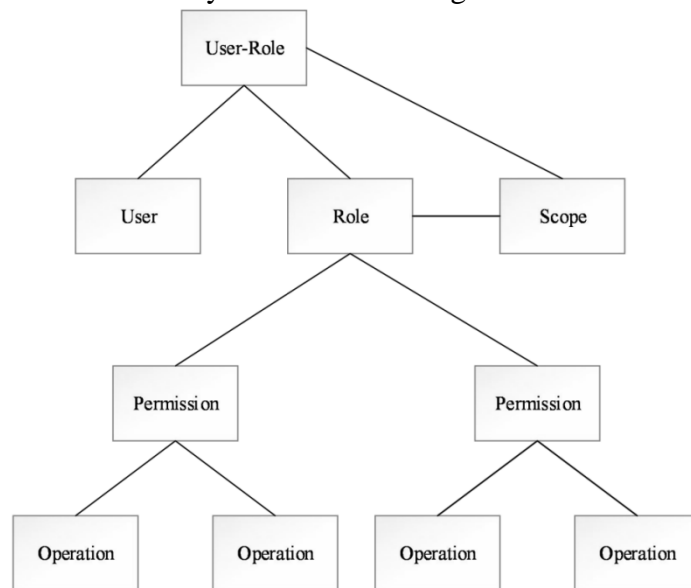

Figure 3: RBAC Model

4. Database Design

Databases are at the core of information management systems. Designing a good database can enhance the availability of the entire system. The data security management module needs to store the public and private keys separately. In order to meet the security requirements, at least two databases are needed. For the functions related to human resource management, a relational database is needed. As for storing the key part, we can use Non-SQL Table Storage.

4.1 Employee Basic Information Table

The employee basic information should include the employee ID, which should be an index and cannot be empty. Each employee must have and can only have one employee ID, so this attribute is

set as an index and cannot be empty. The employee basic information also includes the employee's name, gender, identity information, department information, position, level, public key, marital status, ethnicity, native place, political affiliation, contact number, and email address, etc. All of the above information is non-simple data types, so external data tables are referenced and used here. For the name, identity information, CAS, and public key, these are all unique identifiers for an employee, so these attributes should be indexes. All attributes are important components of employee basic information, so all data cannot be empty.

4.2 Database stored procedure design

Stored procedures are a set of SQL statements designed to perform specific functions in large relational database systems. They are stored in the database and do not need to be recompiled when called again after the initial compilation. Users can execute them by specifying the name of the stored procedure and providing arguments (if the stored procedure has parameters). Stored procedures are an important object in a well-designed database application and are used in many scenarios.

For all insert operations on database tables, the system has written stored procedures. In these stored procedures, a GUID is automatically generated as the record's ID, so the caller does not need to include the ID in the logical code. Default values are also specified for many columns, so when the caller uses the method, they do not need to send uncertain or non-universal fields, which greatly reduces the amount of requested data and improves access efficiency.

4.3 Database trigger design

Triggers are a method provided by SQL Server to ensure data integrity for data analysts and programmers. They are special stored procedures related to database table events. They are not manually started or called by programs, but are triggered by events. For example, when an operation (INSERT, UPDATE, DELETE) is performed on a table, the trigger is activated and executed.

In this database, triggers are mainly used when creating employee profiles. When colleagues in the human resources department send requests to create new employee profiles, the actual database operation is to insert a record into the employee basic information table. At this time, the trigger detects the INSERT action and automatically creates records for EMAIL, IMInfo, name, and other information in the database table. This greatly improves the system's execution efficiency and ensures high availability. Developers do not need to write a large number of SQL statements for creating employee profiles, which greatly reduces bandwidth and significantly improves system efficiency.

4.4 Database Security Design

This system uses both relational database MS SQL Server and non-relational database Table Storage. The handling of database security differs between the two. For SQL Server, user accounts are created based on the minimum permission requirements of the system. A separation mechanism is used between the testing and production environments. For the production environment, the operations team regularly updates the database user keys. However, Table Storage does not have the same comprehensive security mechanisms as relational databases. The access to Table Storage is achieved through Web Call, and the authentication of requests is generated through the corresponding key of the storage. Therefore, the security handling of Table Storage involves regular key updates, regeneration of Storage Table keys, and updating them in the Cloud Service.

The data security management module in this system consists of two parts: data encryption and decryption, and key rotation. The same asymmetric encryption algorithm is used for data encryption. Firstly, the system generates a pair of keys for each employee, and stores the public and private keys in SQL database and Table Storage respectively. The data is encrypted using the public key and the encrypted ciphertext is stored in the database. When a user requests encrypted data, the system retrieves the private key from Table Storage and translates the data to obtain the plaintext, which is then returned to the user. Key rotation is performed to ensure system security. The system periodically generates new keys, decrypts the ciphertext using the old private key, encrypts it using the new public key, and stores it.

5. Conclusion

This article first presents the overall design of the human resources management system, then provides detailed design for the important functional modules based on the overall design. It also covers the database design, from the database E-R diagram to the table design and database security design. With the human resources management system, almost all application systems can now achieve single sign-on, with the users coming from the CAS system. This brings convenience to the enterprise and improves work efficiency by eliminating the need to maintain multiple user credentials. The article also includes the development engineering structure and design principles.

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