

# *Virtualization of Comprehensive Personnel and Salary Management Based on Blockchain Big Data*

Danqing Wu<sup>1,a,\*</sup>, Mengyi Zai<sup>1,b</sup>, Feng Li<sup>2,c</sup>

<sup>1</sup>Zhejiang Business College, Hangzhou, Zhejiang, China

<sup>2</sup>Technology Department, Guanlan Network Technology Co., Ltd, Hangzhou, Zhejiang, China

<sup>a</sup>384269818@qq.com, <sup>b</sup>895684619@qq.com, <sup>c</sup>929046475@qq.com

\*Corresponding author

**Keywords:** Blockchain Technology, Big Data Technology, Comprehensive Management of Personnel and Salary, Virtualized System

**Abstract:** With the development of digitalization and networking, personnel salary management in enterprises is facing more and more challenges. Traditional human resource management methods often require a lot of manpower and material resources, and there are some problems such as data being opaque and easy to be tampered with. In order to improve efficiency and ensure data security and accuracy, more and more enterprises began to explore the virtualization scheme of comprehensive personnel and salary management based on blockchain big data technology. In order to solve the salary management problem of small and medium-sized enterprises, this paper puts forward virtualization technology, wireless sensor network technology and radio frequency identification technology, and designs and analyzes the virtual comprehensive personnel and salary management. In addition, this paper designs and develops an integrated personal salary management system based on blockchain big data, realizes virtualization technology operation on the system, and tests the function of the system. Finally, the company's employee satisfaction survey shows that the system has good performance and improved the work efficiency of 5-6% employees and managers.

## 1. Introduction

### 1.1 Background

With the development of digitalization and informatization, big data has become an important part of enterprise management. Human resources and salary information is one of the most sensitive data in enterprises, which involves the personal privacy of employees and business secrets of enterprises. Therefore, how to protect these data and realize efficient management has become an important challenge for enterprises.

### 1.2 Significance

It is becoming increasingly difficult to adopt traditional manual salary management mode, and it

is impossible to manage and maintain the salary dynamically. Therefore, in today's information environment, building a set of personnel compensation management systems based on the next generation of agile IoT based on the information technology platform has gradually become a way to improve the company's compensation management level and ability.

### 1.3 Related Work

As a decentralized and distributed data storage and processing method, blockchain can effectively solve these problems. By storing the data in the blockchain, the security and integrity of the data can be ensured, and the management efficiency and transparency can also be improved. Big data analysis can use massive data to analyze and predict, help enterprises better understand the performance and needs of employees, formulate more reasonable salary policies and benefits, and improve the competitiveness and attractiveness of enterprises. On the basis of analyzing the existing problems and problems in the human resource management system, Li Long utilizes the technical characteristics of blockchain to establish a more accurate, efficient, open, and transparent human resource management system for enterprises. The results show that there is a good complementarity between blockchain technology and enterprise human resource management systems [1]. The theme of Abdiyev A C's research is tourism human resource management, with the aim of improving the quality of products and services and achieving greater economic competitiveness in the tourism market. In view of the fact that the task of human resource management of tourism products and services is: highly dependent on high-quality human resources. Ensure high-quality human labor, and achieve maximum efficiency through incentives, education and the possibility of career promotion, and keep it in the commercial sector [2]. In public institutions, human resource management is a key factor in determining their success or failure, but there is currently no systematic method to improve their processes. In the past 20 years, software process improvement and capability evaluation has been a process evaluation framework successfully applied by software companies. This method is used in the government field, and the process definition of public personnel management process is formulated. In order to observe the benefits and usability of the model, Gökalp E conducted several case studies, including evaluating the public personnel management process capability level of three organizations and formulating an action plan for improving the public personnel management process. The research results show that the proposed method is suitable for determining the ability level of public personnel management process and can provide a road map for entering the next level [3]. These studies show the adaptability of blockchain in the field of comprehensive personnel and salary management.

### 1.4 Innovation

The new system involves the field of blockchain technology. It has designed and developed a personnel compensation management system based on virtualization and blockchain technology. It includes a central server, an RFID electronic tag placed on the company seat, and an employee signing in at the company gate. One RFID reader, a second RFID reader installed in the company canteen, and a third RFID reader installed in the company office; The first RFID reader, the second RFID reader, and the third RFID reader are all data connections to a central server. The utility model uses the Internet of Things technology represented by RFID to automatically identify, locate, and monitor the commuting, working hours, and workplaces of enterprise employees, and can automatically record the working hours, overtime, and performance information of enterprise employees, thereby improving the automation level of salary management system information.

## 2. Methods and related concepts

### 2.1 Virtualization Technology

Both the virtualization architecture and the underlying cloud computing architecture are inseparable from the support of virtualization technology. At the same time, in recent years, the emergence of container technology makes the advantages of virtualization technology to the fullest [4]. The historical evolution of the virtual machine is shown in Figure 1:

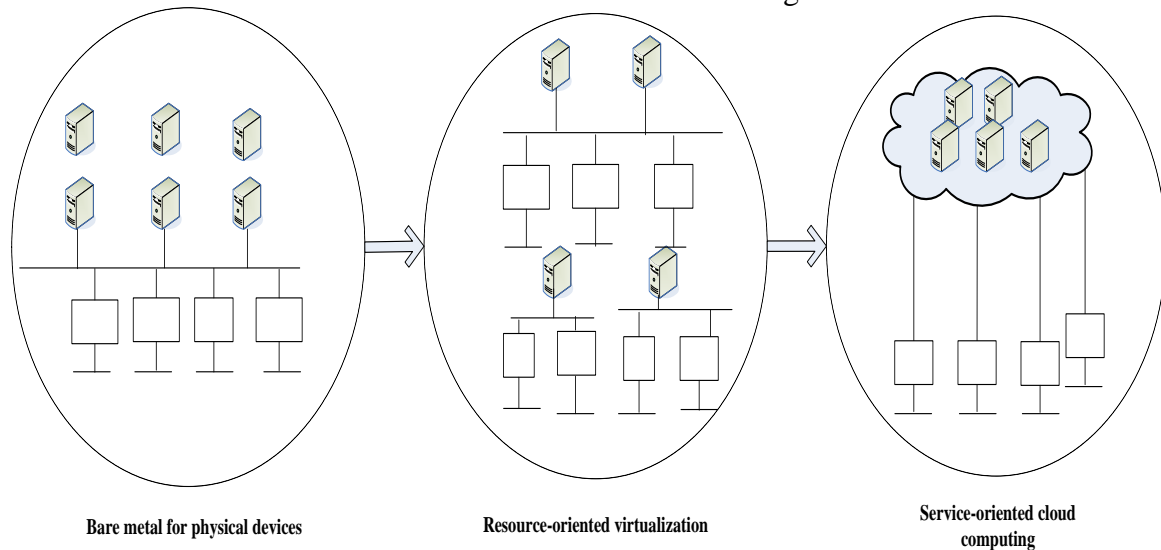


Figure 1: Historical evolution of virtual machines

In addition to server virtualization, virtualization technology has further expanded to other areas, such as networking and storage devices. At the network level, the development of virtualization technology can be divided into four categories according to the order of development: (1) According to elements such as network functions and specific applications, the network is divided into different logical domains. They can be respectively used as a broadcast domain, and the network the method of dividing into multiple virtual network segments is called VLAN (virtual local area network) technology. (2) A dedicated and independent logical communication link is virtualized through a specific communication and encryption protocol. The user feels as if the network is monopolized the same method is called VPN (Virtual Private Network) technology. (3) An application layer network with virtual topology built on the Internet is called an overlay network (ON). It usually stands for flexible overlay networks, content delivery networks, and peer-to-peer networks. (4) A network that virtualizes nodes and links is called VN (virtual network) technology. Virtual nodes refer to virtualized network devices, and virtual links refer to virtual nodes. The value of network virtualization technology for service providers is that they can provide users with multiple services by running multiple isolated overlay networks on shared infrastructure, such as broadband Internet access, video, and corporate VPN services. Etc. This way of running multiple logically separated virtual networks on the same physical network can significantly reduce infrastructure management and maintenance costs. Network virtualization has greatly influenced and promoted the development of network protocols and networks [5].

### 2.2 Key Technologies of Big Data Based on Blockchain

There are many key technologies of modern blockchain and big data, mainly including the following aspects:

(1) Infrared is a wireless communication technology that uses infrared as the carrier wave. It is generally used in keyboards, mice, remote controls, etc. Infrared wireless communication technology is only suitable for low-cost cross-platform device data exchange; ZigBee technology is an emerging wireless network technology. Developed, it has the functions of short transmission distance and fast processing speed, and has the characteristics of simplicity, energy saving and low cost[6-7].

(2) Radio frequency identification (RFID) technology

RFID tag is the data carrier of RFID system, used to identify the target object, just like the barcode on the package of goods, scan it You can know a series of information such as the place of production and price of the product. An RFID tag is a product that integrates many circuits, some of which include radio frequency interface circuits and resonant circuits. Suppose the number of AP points in the system is n, the number of auxiliary reference point tags is m, and the number of tags to be located is u[8-9]. For markers to be located, the signal strength vector measured by AP is  $S=(S_1, S_2, \dots, S_n)$ , for the baseline label, the signal strength vector measured by AP is  $S=(S_1, S_2, \dots, S_n)$  was measured. As shown in formula (1):

$$Q_k = \sqrt{\sum_{j=1}^n (s_j - s_{kj})^2}, k = 1, 2, \dots, m \quad (1)$$

Geometrically, m Euclidean distances can form a set of vectors as shown in formula (2):

$$Q = (Q_1, Q_2, \dots, Q_m) \quad (2)$$

Secondly, according to the K nearest neighbor method, the values in Q are incrementally sorted, and the optimal K values are selected from them[10-11]. They are multiplied by the weight coefficient w to obtain the weight sum of the corresponding position coordinates. Available[12]:

$$(m, n) = \sum_{j=1}^K w_j(m_j, n_j) \quad (3)$$

Among them, the weighting coefficient w is calculated by empirical measurement, and the mathematical expression is shown in formula (4):

$$w = \frac{Q_j^2}{\sum_{j=1}^K Q_j^2} \quad (4)$$

The principle of LANDMARC is shown in Figure 2:

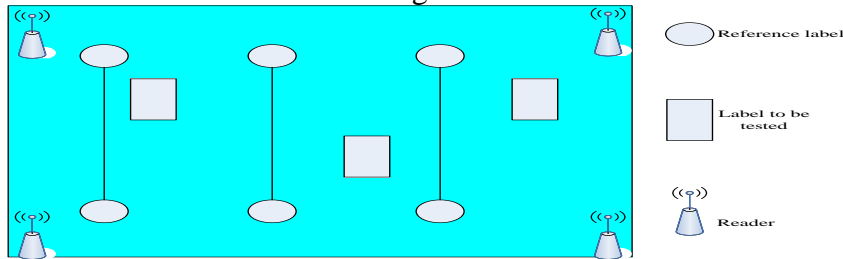


Figure 2: Schematic diagram of LANDMARC positioning algorithm

The algorithm has the advantages of small computational complexity, fast processing speed, and obvious results. The process is as follows: After the LANDMARC positioning system is established, each AP obtains the signal strength value vector  $Q_m$  of all reference tags [13-14]. Then, k groups of RSSI values are obtained for each reference label, and the maximum ten groups are combined into a

calculation group, and the maximum and minimum values are removed to calculate the stable average. Next, evaluate the mean  $\mu$  and standard deviation  $\sigma$  of the signal samples. As shown in formula (5) and formula (6).

$$\mu = \frac{1}{k} \sum_{n=1}^k RSSI_n \quad (5)$$

$$\sigma = \sqrt{\frac{1}{k} \sum_{n=1}^k (RSSI_n - \mu)^2} \quad (6)$$

Accept the data in the range of  $(\mu-0.5\sigma, \mu+\sigma)$  to obtain the filtered signal strength. Finally, calculate the mean  $\mu_n$  and the original variance  $\sigma_n$  as the fingerprint information  $G$  of the reference label and store it in the fingerprint database.  $G$  is shown in formula (7), where  $n \in (1, m)$ ,  $k \in (1, l)$ . After obtaining the fingerprint data of all reference marks in the AP system, a complete offline fingerprint database was constructed.

$$G_n = (a_n, b_n, \mu_1, \mu_2, \dots, \mu_k, \sigma_1, \sigma_2, \dots, \sigma_k) \quad (7)$$

The selection of the  $K$  value has a great influence on the accuracy of the LANDMARC positioning system. Generally, the positioning accuracy reaches a high level when  $k=3,4,5$ . When the tag to be located is equally likely to appear in an indoor environment, the deployment method of the reference tag directly determines the optimal  $k$  value selection. After selecting the three smallest values in the  $Q$  vector, the coordinate points of the three reference labels are used as the center of the circle, and the  $4/5$  length between the centers of the two circles is the radius to make three circles. The purpose of taking  $4/5$  is to increase the possibility of three circles intersecting two by one.

### (3) Cloud computing technology

Cloud computing is a modern technology that uses network computing. It can provide computers and other devices with the ability to share resource information [15]. It can realize network access to shared configurable resources, which can be provided and delivered very quickly. The biggest benefit brought by cloud computing is to improve the management and analysis speed of various items in the Internet of Things, and to make server nodes more reliable, while also solving the problem of resource constraints .

## 3. Virtualization Design Experiment of the Comprehensive Management System of Personnel and Salary

### 3.1 Overall System Architecture

We need to start from the overall direction of the system, select the appropriate system development software and development environment, and determine the various functional modules of the system. In the process of system design and development, we must adhere to the principles of openness and standardization, and fully consider the stability, security and data consistency of the system, so that the entire system developed has easy to use, flexible procedures, and fast data updates and advanced features of performance appraisal methods [16]. System function analysis is completed on the basis of the overall task of system development. Realizing the systematization, standardization and automation of employee salary management information for small and medium-sized enterprises is the overall task of this system development. The continuous and rapid development of computer technology has made computer technology widely used in various production and management links of enterprises, and employee salary management also requires the

use of computer technology. Therefore, when designing this system, we should try our best to make the system easy to operate, simple in interface, flexible in use, practical and effective. The application architecture of this system is shown in Figure 3:

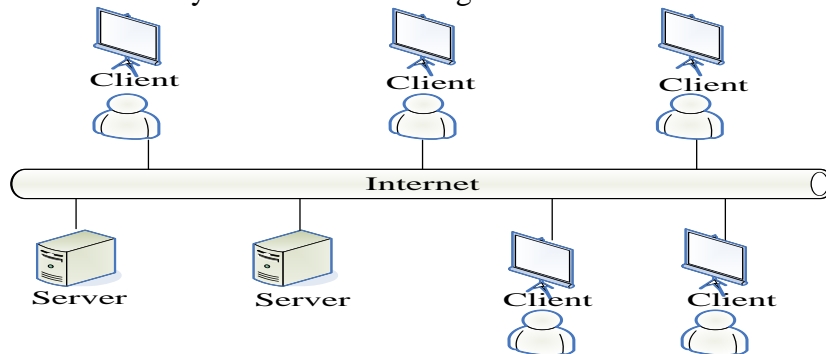


Figure 3: Integrated management system for personnel and salary

### 3.2 Analyze the functions of various parts of the system

Through the analysis of the system's needs, the system is finally divided into three major modules, namely: personnel management module, salary management module, and user management module for small and medium-sized enterprises. The specific system module framework diagram is shown in Figure 4:

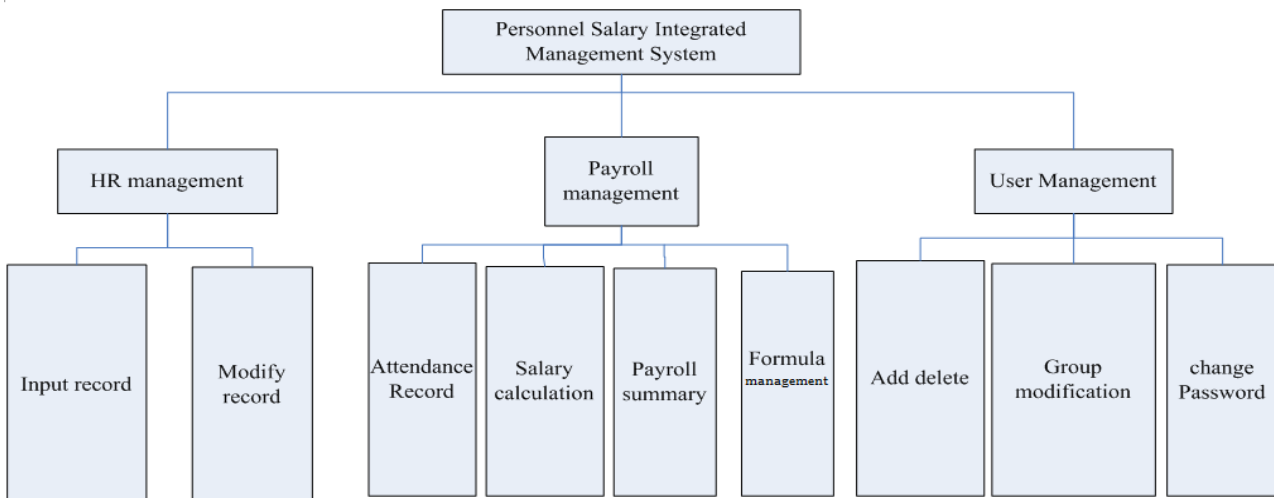


Figure 4: System Structure Diagram

### 3.3 System data requirements in databases and the design of related data tables

- (1) Data requirements of the comprehensive management system of personnel and salary
- (2) The design of the relevant data table of the comprehensive management system of personnel and salary

The foundation of the database model is the E-R model, but the E-R model has nothing to do with the data model. The logical model of the database is to transform the E-R model of the database into a specific data model that the mysql database can recognize. The structure of each entity table is introduced below:

- (1) Employee information table: store basic information of employees, such as name, age, education, major, telephone number, home address, etc. The specific content is shown in Table 1:

Table 1: Employee Information Table

Field name	Data type	length	Remarks
Number	char	20	Primary key
Name	Char	20	
Photo	Char	8	
gender	varchar	2	
age	Int	2	
ID_card	Char	18	
Education	Char	6	
profession	Char	6	
Title	Char	10	
Family	Char	30	
email	Char	30	
Job	Char	5	
Phone number	Char	11	

(2) Employee Attendance Sheet: save the detailed information of employee attendance, the content is shown in Table 2:

Table 2: Employee Attendance Table

Field name	Data type	length	Remarks
ID	varchar	10	Primary key
date	varchar	10	
department	varchar	20	
empID	varchar	10	
name	char	20	
empdate	char	10	
Attendance	varchar	10	
sick leave	varchar	10	
Personal leave	varchar	10	
Late and leave early	varchar	10	
Overtime	varchar	10	
Business trip	varchar	10	
Absenteeism	varchar	10	

(3) Employee performance appraisal form: the specific situation of assessing the work performance of employees. The content is shown in Table 3:

Table 3: Employee Performance Appraisal Form

Field name	Data type	length	Remarks
ID	varchar	10	Primary key
Name	varchar	10	
AdminID	varchar	20	Foreign key
Capacity	varchar	10	
Achievement	char	20	
Innovate	char	10	
Character	varchar	10	

(4) Employee basic salary table: save the detailed information of employee salary, as shown in

Table 4:

Table 4: Basic salary table

Field name	Data type	length	Remarks
ID	varchar	10	Primary key
Name	varchar	10	
AdminID	varchar	20	Foreign key
Wage jobs	decimal	10	
Lunch subsidy	decimal	20	
Withholding medical insurance	decimal	10	
Withholding tax	decimal	10	
Overtime pay	decimal	9	
Actual salary	decimal	9	
Payable	decimal	9	
Date	decimal	8	

#### 4. System Function Test and Satisfaction Survey

##### 4.1 System Function Test

The function of software testing is to use a small set of test cases to test out some undiscovered errors. To fully implement the test, the most important link is the design of test cases. The classification of testing technology is based on the actual needs in the testing process, and there are two categories of static and dynamic testing. There are two test methods, namely analytical methods and non-analytical methods. Among them, there are two analysis methods: static analysis method and white box method. The non-analytical method is also called the black box method. The testing method of personnel salary management is to organically link the static and dynamic testing techniques together. Static testing technology mainly finds errors from requirements analysis, structural inspection, design, flow graph analysis, etc. During this process, the system software is not executed. The execution of dynamic test technology is a supplement to the test procedure, and the conclusions in the execution process are used to find out the procedure error. The test of this system organically links the white box method and the black box method. White box methods, test the "business logic" of the system, from the situation of business logic, the gap between the test and the target.

Through various tests on the personnel and salary management system of small and medium-sized enterprises, the quality of the system is ensured. The test is carried out jointly by the user and the software developer, and the dynamic test is carried out according to the business and actual conditions of the system, covering the main functions of the system, especially the comprehensive test of the core technology system of the system. The problems found during the test mainly include functional problems, stability problems, program problems and user-friendliness, etc. The actual problems of the system are relatively few. Judging from the actual operation effect, the development of this software has reached the design goals, completed the work tasks, and greatly improved the efficiency of educational administration management.

##### 4.2 Corporate Employee Satisfaction Survey

After completing the overall system design and functional module requirements analysis, we



conducted a simulation experiment on the personnel compensation integrated management system based on the next generation of agile Internet of Things in the next few months. We invited 102 employees and managers of different ages from several small and medium-sized enterprises in a city. A questionnaire survey was conducted on the virtual personnel compensation integrated management system designed in this paper. A total of 102 questionnaires were distributed, 101 were recovered, and one invalid questionnaire was eliminated, leaving 100. We made a statistical description of the results of this questionnaire survey. The result is shown in Figure 5.

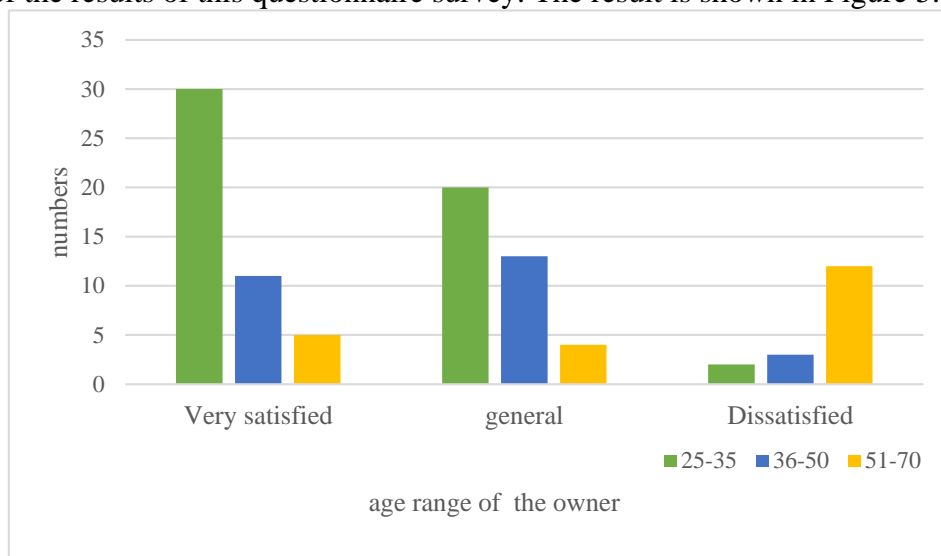


Figure 5: Enterprise employee satisfaction survey

As can be seen from Figure 5, most young employees and management are satisfied with the personnel and salary comprehensive management system designed this time, and think that the system can reduce the workload of management, improve their work efficiency, and enable employees to know their salary in real time. However, a small number of old employees are not satisfied with the personnel and salary management system designed this time. They think that the comprehensive management system of personnel compensation designed this time is not practical, and that some practical policies should be introduced to encourage employees to work harder and make money. To sum up, it can be concluded that the functions of the system perform well, which is conducive to helping enterprise managers manage enterprises efficiently.

## 5. Conclusions

Virtualization of comprehensive personnel and salary management based on blockchain big data is a feasible solution. First of all, blockchain technology can realize decentralized storage and management of data, and ensure the reliability and security of data. Secondly, using big data technology can deeply mine and analyze all kinds of information, which improves the accuracy and efficiency of decision-making. In the comprehensive management of personnel and salary, virtualization technology can integrate the information of different departments and positions. In this process, blockchain technology can ensure the authenticity and integrity of data. At the same time, combined with big data technology, we can monitor and analyze employees' performance, salary and other information in real time, so as to better formulate salary policies and incentives. In a word, the virtualization of comprehensive personnel and salary management based on blockchain big data can effectively solve the problems of information island and inaccurate data in traditional human resource management, improve enterprise management efficiency and decision-making level, and has a very broad application prospect. Accordingly, the next system development will mainly

focus on the following aspects:

(1) Continuously improve and expand the system database

If the system is put into use, as the number of users continues to increase, the information that needs to be stored and processed will increase. This undoubtedly puts forward more stringent requirements for database system management. The system management should use MYSQL technology to continuously improve and optimize the system.

(2) Increase system function modules

In the application and promotion of the system, some functional modules that were missing in the previous system will definitely be produced, which requires the addition of system functional modules. The system should add some functional modules in a targeted manner, so as to meet the actual needs of employee salary management.

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