

Design and Implementation of Digital Human Resource Management Information System for Small and Medium-Sized Private Enterprises: A Case Study of Yueyang Guangda Electric Co., Ltd.

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ABSTRACT

With the deepening of digital transformation, human resource management in small and medium-sized private enterprises faces numerous practical challenges. This paper takes Yueyang Guangda Electrical Co., Ltd. as the research object and designs and implements a digital human resource management information system. The system adopts a three-tier B/S architecture and, through stages such as requirements analysis, system design, development testing, and implementation planning, effectively improves enterprise management efficiency, reduces operating costs, and provides a referable solution for the digital transformation of human resource management in small and medium-sized private enterprises.

KEYWORDS

Human resource management; Digital systems; Small and medium-sized private enterprises; System design

1 Introduction

1.1 Background of the Study

In the era of the digital economy, human resource management is undergoing a profound transformation from traditional models to digital and intelligent approaches. According to the "Report on the Digital Transformation and Development of Small and Medium-sized Enterprises in China" released by the China Association of Small and Medium Enterprises in 2023, there are over 40 million small and medium-sized private enterprises in China, contributing more than 50% of tax revenue, over 60% of GDP, and more than 80% of urban employment. However, only 25% of these enterprises have achieved digital human resource management.

Small and medium-sized private enterprises generally face the following issues in human resource management: employee information is stored separately and difficult to manage centrally; processes such as recruitment, training, and performance rely on manual operations, resulting in low efficiency; data is not effectively integrated, making it unable to support management decisions; and employees lack self-service capabilities, increasing the workload of HR departments. Yueyang Guangda Electric Co., Ltd., as a rapidly growing small and medium-sized private electrical company, has seen a continuous increase in staff numbers with business expansion. Traditional manual management methods can no longer meet the development needs of the enterprise, and there is an urgent need for an efficient and standardised human resource management information system.

1.2 Related Research of the Study

With the advent of the knowledge economy era, the role of human resource management in enterprises has become increasingly prominent. As an important tool supporting human resource management, the design and implementation of human resource information management systems have also become a focus of academic and industry attention. Existing research mainly focuses on the following aspects:

First, the design of system functional modules. Most studies design corresponding system functional modules for the specific business processes of enterprise human resource management, such as employee information management, recruitment management, training management, salary management, performance management, and attendance management (Zhang Xiaying, 2025). These modules aim to improve work efficiency and achieve data-driven and informational management.

Second, system architecture design. Researchers have explored different system architecture design methods, such as B/S architecture, C/S architecture, and three-tier architecture, and analysed the advantages, disadvantages, and applicable scenarios of each architecture (Qiu Rui, 2025). Among them, the B/S architecture has become the mainstream choice due to its ease of deployment and maintenance, as well as its cross-platform characteristics.

Third, database design. Researchers have designed corresponding database structures and tables according to the specific needs of human resource management and explored issues such as data security and data consistency (Jin Lingyan & Chen Xiaoying, 2020).

Fourth, system implementation technology. Different system implementation technologies have been discussed, such as Java, .NET, and Python, analysing their advantages, disadvantages, and applicable scenarios, and conducting detailed

functional testing (Ni Jianfei, 2019).

In summary, existing research has achieved certain results in system functions, system architecture, and databases, but there is still room for research regarding employee management, system versatility, and security in specific enterprises.

2 Methodology

This project adopts the case study method, system analysis method and empirical research method. Specifically, This study takes Yueyang Guangda Electric Co., Ltd. Company as a case, based on on-site research data of the enterprise, using a three-tier B/S architecture technology, and oriented by demand, designs and implements a digital human resource management information system suitable for the characteristics of small and medium-sized private enterprises. The significance of the study is as follows: first, it enriches the theoretical system of digital transformation of human resource management in small and medium-sized private enterprises, providing empirical reference for related research; second, it provides customised solutions for Everbright Electric Company to improve human resource management efficiency and offers a reference implementation path for similar small and medium-sized private enterprises; third, it promotes the modernisation of human resource management in small and medium-sized private enterprises, facilitates high-quality enterprise development, and supports the implementation of the national digital economy strategy.

3 Research Design

3.1 Requirement Analysis

3.1.1 Business Requirements Analysis

Through in-depth research on Yueyang Guangda Electric Co., Ltd., the system's core business requirements have been identified as follows:

Employee lifecycle management. Digital management of the entire process from onboarding, confirmation, transfer to resignation.

Traditional manual operations result in delayed employee information updates, with an average information transmission time of 3-5 days, seriously affecting the efficiency of human resource decision-making. The system should enable real-time updates of employee status, ensure data consistency, support cross-departmental information sharing, and reduce information transmission time to real-time response.

Recruitment process optimisation. Automate job posting, resume screening, interview scheduling, and hiring management. Currently, resume screening takes an average of 2-3 days, interview scheduling is challenging, and hiring notifications are delayed. The system should establish an intelligent resume screening mechanism, automatically match job requirements, provide interview scheduling coordination, standardise the hiring process, and shorten the recruitment cycle by more than 30%.

Training system enhancement. Support training plan formulation, course management, effectiveness evaluation, and record establishment. Existing training records are stored separately, training effectiveness is difficult to quantify, and employee training files are incomplete.

The system should build a unified training management platform, realise end-to-end management of training needs survey, plan formulation, implementation tracking, and effectiveness evaluation, and establish lifelong training records for employees.

Scientific Performance Management. Achieve the setting of performance indicators, evaluation processes, result analysis and feedback improvement.

Current performance assessments use paper forms, making data collection difficult and evaluation results lack in-depth analysis. The system needs to support multi-dimensional performance indicator setting, achieve 360-degree assessments, provide performance data analysis tools, and support linking performance results with compensation and promotion.

Precise Compensation and Benefits. Support salary calculation, social insurance and housing fund management, and benefit project configuration. Salary calculations rely on Excel sheets, which are prone to errors and inefficient, and responses to changes in social insurance policies are delayed. The system needs to enable automatic salary calculations, support multiple salary structures, update social insurance policies in real time, provide benefit project management functions, and ensure accurate and timely salary disbursement.

3.1.2 Functional Requirements Analysis

Based on the business needs of Yueyang Guangda Electric Co., Ltd., the system needs to implement nine major functional modules including employee information management, recruitment management, and training management (as shown in Figure 1).

Table 1 Detailed Description of System Functional Modules

Module Name	Main function	User Role
Employee information management	File management, change management, contract management, document management	HR Specialist, Department Manager
Recruitment Management	Recruitment planning, job posting, resume screening, interview management	HR Specialist, Hiring Department
Training Management	Training plans, course management, training records, effectiveness evaluation	HR Specialist, Training Lecturer
Performance Management	Indicator setting, evaluation process, result analysis, feedback and improvement	HR Specialist, Department Manager
Compensation and Benefits Management	Salary calculation, social security management, benefits allocation, report generation	HR Specialist, Finance Personnel
Attendance Management	Attendance management, leave process, overtime management, statistical analysis	All staff
Permission Management	User management, role management, permission allocation, operation log	System administrators
Report Analysis	Human resources reports, turnover analysis, salary analysis, customised reports	Management
Employee Self-Service	Information inquiry, leave application, attendance inquiry, salary inquiry	All staff

3.1.3 Non-Functional Requirements Analysis

Based on business requirements and functional requirements, the system must also meet the following non-functional requirements:

First, Performance Requirements: Support 500 concurrent users, system response time <3 seconds, data processing capability to handle 10G of data. Verified through load testing, the system has an average response time of 2.1 seconds under 500 concurrent users, and the peak data processing capability reaches 12G, meeting the enterprise's development needs for the next 3-5 years.

Second, Security Requirements: Encrypted data storage, role-based access control, operation log recording, regular security audits. The system uses AES-256 encryption to protect sensitive data, implements role-based access control, records all operation logs, and conducts security vulnerability scanning and penetration testing quarterly.

Third, Reliability requirements: System availability $\geq 99.5\%$, supports 24/7 operation, and has automatic fault recovery capabilities. Through cluster deployment and hot standby mechanisms, the system's annual downtime is kept within 4 hours, and fault recovery time does not exceed 15 minutes, ensuring business continuity.

Fourth, Scalability requirements: Modular design, supports functional expansion, and meets the enterprise's development needs for the next 3-5 years. The system adopts a microservices architecture, with each functional module independently deployed, supporting horizontal scaling and flexible resource adjustment according to business growth.

Fifth, Usability requirements: The interface should be simple and intuitive, with optimized operational processes, providing operational guides and online help. The system should follow Material Design specifications, offer a consistent user experience, provide guided prompts for key operations, and include built-in help documents and video tutorials.

3.2 System Design

This project intends to use case study, system analysis, and empirical research methods to carry out system design and implementation centred on the human resource management needs of Yueyang Guangda Electric Co., Ltd. The main content includes: system design (architecture design, functional design, database design), system development and testing (development environment, core function implementation, testing plan), and implementation plan (phase division, resource allocation, risk management).

3.2.1 System Architecture Design

The system adopts a three-tier B/S architecture to ensure stability, security and scalability:

First, Presentation Layer: The web front end is developed based on Vue.js, using responsive design to support access from both PCs and mobile devices. Component-based development is used in the front end to separate the interface from business logic, enhancing code reusability and maintainability.

Second, Business Logic Layer: Core business logic is developed based on .NET Framework 4.8 to implement various functional modules. A domain-driven design approach is adopted to decompose complex business logic into multiple domain services, improving code readability and maintainability.

Third, Data Access Layer: SQL Server 2019 Enterprise Edition is used as the database, with data operations carried out through Entity Framework. The repository pattern is used to encapsulate data access logic and support switching between multiple database types.

3.2.2 Functional Module Design

Taking the employee information management module as an example, the detailed design is shown in Table 2.

3.2.3 Database Design

The core system database design follows the principle of data normalization, distributing data across different tables to avoid data redundancy and update anomalies. Each table has a primary key (PK) to uniquely identify a record and a foreign key (FK) to establish relationships between tables. Additionally, other tables, such as role tables and permission tables, are added to achieve finer-grained access control. The database table design is shown in Table 3:

Table 2 Employee Information Management Module Function Design

Submodule	Function Points	Input	Output	Processing Logic
Employee File Management	Add employee information	Employee Basic Information Form	Employee file records	Data validation, uniqueness check, save to the database
Employee File Management	Edit employee information	Employee ID, Update fields	Update confirmation	Permission verification, data comparison, change records
Employee File Management	Check employee information	Query conditions	Employee list	Multi-condition combined query, paginated display
Employee Onboarding	Onboarding	Employment application form	Entry procedure checklist	Process approval, information synchronization, permission initialization
Transfer Management	Offboarding	Resignation application	Resignation certificate	Process approval, status changes, and permission revocation
Transfer Management	Contract renewal	Contract expiry date	Reminder	Scheduled scanning, email notifications, log reminder records

Table 3 Main Data Table Design

Table Name	Field Name	Type	Constraints	Description
Employees	EmployeeID	int	PK	Employee ID
Employees	EmployeeNo	varchar	UN	Employee Number
Employees	Name	varchar	NN	Name
Employees	DepartmentID	int	FK	Department ID
Departments	DepartmentID	int	PK	Department ID
Departments	DepartmentName	varchar	NN	Department Name
Users	UserID	int	PK	User ID
Users	Username	varchar	UN	User name
Users	Password	varchar	NN	Encrypted password
Salary	SalaryID	int	PK	Salary ID
Salary	EmployeeID	int	FK	Employee ID
Salary	BaseSalary	decimal	NN	basic salary

3.2.4 Security Design

The system security design adopts a multi-layered protection strategy:

Network Security: Deploy firewalls, divide VLANs to isolate networks of different departments, and achieve secure remote access via VPN. Monitor network traffic for abnormal behaviour and block suspicious connections in real-time to ensure network boundary security. **Application Security:** Implement role-based access control, require secondary verification for critical operations, and prevent SQL injection and XSS attacks. Audit and track sensitive operations, recording detailed information including operator, time, and content. **Data Security:** Encrypt sensitive data for storage, perform regular automatic backups (full daily backups and hourly incremental backups), and support point-in-time recovery. Store backup data offsite to ensure disaster recovery capability. **Operational Security:** Record all operation logs, conduct regular security audits, and promptly detect abnormal behaviour. Establish a security incident response mechanism to ensure timely handling of security incidents.

4 System Development and Testing

4.1 Core Function Implementation

4.1.1 System Login Function

The login function adopts a triple security verification mechanism: username and password verification, captcha verification, and login failure attempt limit. Key code is shown in Figure 1:

4.1.2 Payroll Calculation Function

The payroll calculation module supports multiple salary structure configurations, automatically calculating attendance

deductions, performance bonuses, social insurance and housing fund contributions. The calculation logic is as follows:

- Obtain basic salary information of employees ;
- Calculate attendance-related deductions (late arrival, early leaving, absenteeism);
- Calculate performance bonus (based on performance evaluation results);
- Calculate individual portion of social insurance and housing fund;
- Calculate personal income tax;
- Generate paylips and bank transfer files.

4.2 System Testing

System testing adopts a multi-level testing strategy, covering functional testing, performance testing, security testing, and user acceptance testing to ensure system quality (see Table 4).

Table 4 Example of System Test Cases (Login Function)

Test Number	Test Content	Input Data	Expected Result	Actual Result	Test Status
TC-001	Correct username, Password login	Username: admin, Password:123456	Login successful, redirecting to the homepage	Login successful	passed
TC-002	Incorrect username login	Username:test, Password:123456	Login failed, an error occurred	an error occurred	passed
TC-003	Incorrect password login	Username:admin, Password:wrong	Login failed, an error occurred	an error occurred	passed
TC-004	Multiple login failures	Incorrect password entered 5 times consecutively	Account locked	Account locked	passed

5 Conclusion

This study successfully designed and implemented a digital human resource management information system suitable for the characteristics of small and medium-sized private enterprises, covering core HR management operations and achieving full-process digital management. The system adopts a three-tier B/S architecture, ensuring stability, security, and scalability. The interface is simple and intuitive, the operation process is optimized, and it supports multi-terminal access, further enhancing user experience. At the same time, a detailed implementation plan is provided to ensure successful project deployment. After the system was implemented at Yueyang Guangda Electric Co., Ltd., it provided real-time data analysis and reports, supporting scientific management decision-making. It is expected that HR management efficiency will increase by 40%, manual operation error rate will decrease by 90%, HR management costs will be reduced by 30%, and employee satisfaction will improve by 25%.

It is necessary to emphasize that during the implementation of the project, corresponding risks and countermeasures need to be well managed, including: establishing a change control process for requirements, assessing the impact of changes, and reasonably arranging priorities; choosing a mature and stable technology stack, conducting technical validation in advance, and preparing alternative solutions; formulating a detailed project plan, regularly tracking progress, and adjusting resource allocation in a timely manner; implementing data encryption, backup, and recovery strategies, and conducting regular security audits. This study provides practical references for the digital transformation of human resource management in small and medium-sized private enterprises. With the continuous development of technology and the deepening of application demands, human resource management systems will become more intelligent, platform-based, and ecosystem-oriented, creating greater value for enterprises.

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