

Design and Implementation of Building Safety Production Inspection Management System based on Internet Technology

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Abstract. At present, most of the domestic building safety inspection managements are completed by manual recording and photo evidence, these methods not only consume a lot of manpower and resources, but also have the disadvantages of low efficiency and high error rate. With the deepening application of computer and Internet technology in all walks of life, it provides an opportunity for information development of the safety inspection management as well as the improvement of management efficiency. The purpose of this paper is to design and develop a web-based safety inspection system. The system consists of mobile client software and cloud platform software. The mobile client is based on the Java language, it has the function of mobile client for security inspection management function, while the cloud platform adopts B/S structure and J2EE+SQL server mode, it is convenient to data storage and management. The researches of this paper have ameliorated manual and papery way of safety inspection. At the same time, by using of internet technology, the informatization level and management efficiency of production safety inspection has been improved.

Keywords: internet technology, System design, Safety Production Inspection Management.

1. Introduction

The proportion of the building industry in the national GDP is close to 30% and plays an important role in the national economic development [1]. However, the safety form of China's building industry is not optimistic. According to the statistics of safety accidents in the industrial, mining and trading industries of China in 2015, there were 175 large safety accidents in the whole year, and the death toll of 36 large safety accidents in the building industry reaches 143, which is the most among industries [2]. The safety production of building construction not only relates to the safety of people's property and life, but also affects the harmonious stability of society [3]. The State has formulated and amended such laws and regulations as the Safety Production Law of the People's Republic of China in order to pay more attention to the work of safety production [4].

At present, the research at home and abroad mainly focuses on management system and risk assessment of safety production. With the improvement of international level of design, procurement and construction management in domestic building industry, the development level of China's building industry in management system has been in line with international standards [5]. However, China is still at a relatively backward level in safety management technology, which is mainly due to the inherent thinking of manual safety inspection operation on construction site, and the limitation of hardware level of safety inspection equipment and Internet software level [6].

In order to overcome the safety hidden trouble caused by manual error of safety inspection management on construction site, improve the efficiency of safety inspection and reduce the management cost, this paper aims to study a set of safety production inspection system. Firstly, the paper explains the technical basis, then designs the system function framework on the basis of the function requirement of the safety production inspection system, realizes the expected function of the system through software programming and debugging, and presents the related functions. The system can boast the functions of safety production self-inspection, patrol inspection, remote real-time upload of inspection records, and filing of safety production records, and has important guiding significance for improving the information level of building construction.

2. Computer Application Technology

2.1 Mobile Client Development Technology

The application program development of the mobile phone clients of the system mainly uses Java language for development, specifically, Java EE. Java EE is a multi-layered, distributed, component-based enterprise application model proposed by Sun Company [7]. With Java language as the foundation of Java EE, the whole architecture of the system is described by Java language category, and all Java EE application servers are carried out with Java language.

The task of Java EE is to provide a stand-alone, portable, multi-user, secure, and standard enterprise platform whose server page deployment is done with Java technology. Java EE is mainly used to create extensible enterprise applications, including 13 core technical specifications[8].(1) JDBC (Java Database Connectivity); (2) JNDI (Java Naming and Directory Interface); (3) EJB (Enterprise Java Bean); (4) RMI (Remote Method Invocation); (5) JSP (Java Server Pages); (6) Servlet; (7) XML (e Xtensible Markup Language); (8) JMS (Java Messaging Service); (9) IDL (Interface Description Language); (10) JTA (Java Transaction Architecture); (11) JTS (Java Transaction Service); (12) Java Mail; and (13) JAF (Java Bean Activation Framework).

Java EE, as an industrial standard and mainstream platform for enterprises, formulates many rules for the software development life cycle to standardize coding. In different areas ranging from the design to the release, it has developed different specifications. All of these are closely related to technologies and therefore can be integrated together [9-10]. Figure 1 is a standard overall structure diagram of Java EE.

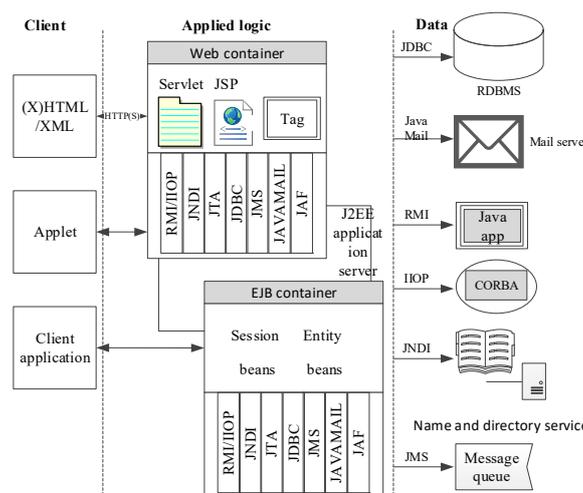


Fig.1 Standard overall structure diagram of Java EE

Java language is a design language based on network programming [10-12]. It is a tool that all programmers need to apply when they create an application program and they can download and apply it once it's designed. Java language is translated into source code, and can also be transformed into the source code in the role of virtual machine, so that the source code can be programs recognized by other electronic devices such as computers, so as to realize the implementation of software and program development.

In that development process of the mobile phone software, in order to protect the stability and security of the software, the correspond user authority needs to be set during the development, that's, the user interface design and the resource acquisition have certain authority setting, and the corresponding resource extraction and program startup can be completed only when the authority allows. This is the protection of the application program, and obtaining authority and naming user authority are also part of the user's use and experience process.

2.2 Cloud Platform Development Technology

The system cloud platform has adopted J2EE as the development platform and MVC as the design pattern. The applied technologies include Java, JSP and SQLServer database.

2.2.1 Overview of MVC Design Pattern

MVC (Model-View-Controller) is a web development design pattern, with multiple language and framework support, and is popular with more and more developers. It compulsorily separates the input, processing, and output of the application, reducing the degree of coupling between modules and providing the expansibility of the application. The whole system structure consists of three modules: model, view and controller, each module assuming different functions [13-14]. Model: The model encapsulates data and data operation. The core data, logical relation and business criteria in the data processing process are all contained in the model. The provided interface can provide services for data processing. View: The view is the interface between the system and the users. It obtains the displayed data from the model or calls the model interface to operate only as the output of the data, which is forwarded by the controller. At J2EE, the JSP page is responsible for displaying the application to the users and displaying the state of the model. Controller: The controller is responsible for the interaction between the view and the model, which is served by Servlet in J2EE, which controls user input, reads data from the view, and passes instructions to different model processes, and the results of the processes are displayed by the view. The controller does not process and store any data, nor does it return any content to the users, and it only controls forwarding.

2.2.2 J2EE Architecture and BS Architecture

J2EE (Java 2 Platform Enterprise Edition) is a Java-based language technology architecture, which contains many components, distinguishes the traditional application system development, and simplifies the system development steps, with such features as portability, security and reuse.

B/S structure (Browser/Server mode) is an effective improvement of C/S structure with the development of Internet technology. Most logical transactions are implemented on the server side in the user interface through browser. On the one hand, this reduces the load on the client computer or mobile device and improves the efficiency of system maintenance and upgrade [15]. The data access sequence of B/S mode is from presentation layer to application layer and then to data layer. The system architecture of B/S mode is divided into presentation layer, application layer and data layer.

2.2.3 Database Technology

A great deal of information, such as system user information, building construction information, safety inspection project information, and safety inspection history, needs to be managed in the database on the cloud platform. This system selects SQL Server 2008 as a background database, and SQL Server 2008 is a distributed database management system supporting relational data model, and widely used in B/S architecture [16-17].

Java program must go through JDBC to directly operate the database, and it's Java API that can execute SQL command and through JDBC, the system developer can directly operate on the database. Using JDBC to operate the database is divided into the following steps: (1) establish a connection with the database; (2) use the method provided by JDBC to send SQL instructions; (3) return the result of the execution operation on the database to the caller.

The system uses the programming advantage of Java language to realize the intelligent terminal control in the mobile phone clients. The cloud platform takes J2EE as the development platform [18-20]. The design pattern based on MVC and SQL database have the functions of remote data transmission, sharing, storage and real-time synchronization. The programming design of computer software technology lays a foundation for the software development of safety production inspection management system. The foreground interface design of the system and the database storage management of the background are carried out according to the function demand and design of the system.

3. Overall Analysis of System Function

3.1 System Functional Requirements

Based on safety production management experience and general steps of safety inspection, the paper analyzes functional requirements of the safety production inspection management system to be developed. See Figure 2 for functional requirements:

The system needs to meet the two aspects of inspection of safety inspection personnel and safety inspection of construction projects. All inspection personnel of the project department can conduct project inspection only after verification of the system. Finally, the system needs to output the inspection report so as to comprehensively evaluate the safety status of the project.

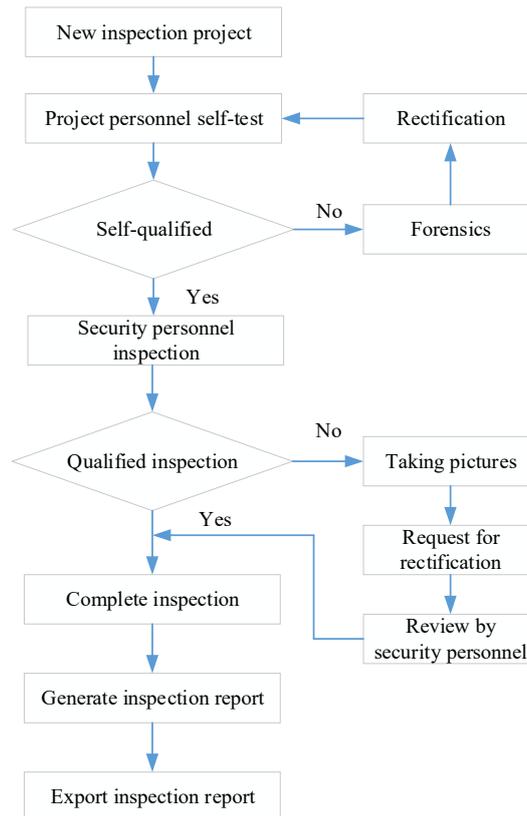


Fig.2 System function requirements framework diagram

The system needs to meet the two aspects of inspection of safety inspection personnel and safety inspection of construction projects. All inspection personnel of the project department can conduct project inspection only after verification of the system. Finally, the system needs to output the inspection report so as to comprehensively evaluate the safety status of the project.

3.2 Design of System Function Architecture

3.2.1 Mobile Client Function Design

Adopting the fourth-generation mobile communication technology - 4G technology, which can transmit data, high quality audio, video and image at high speed, and relying on the mobile intelligent terminal with such functions as photographing, camera shooting, recording, positioning and navigation, and high-speed access to 4G network, a set of Android mobile phone client software is developed using JAVA language. The mobile phone client has the following functions: view project, project self-inspection, project inspection, inquiry and user management. See Figure 3 for preliminary design of functional framework:

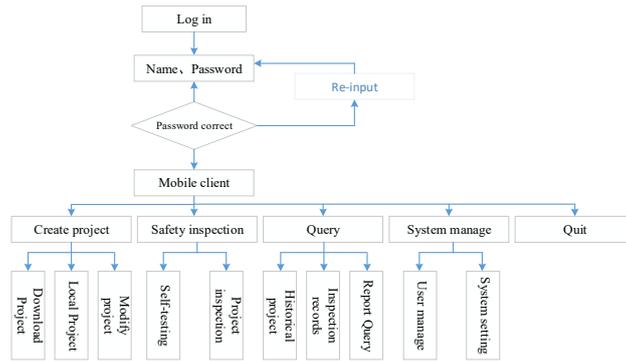


Fig. 3 Function module diagram of mobile clients

3.2.2 Design of Cloud Platform Function of the System

Relying on the cloud server with distributed storage and resource sharing function, a cloud platform of safety production inspection management system is developed by using the cloud computing technology and adopting the J2EE + SQL Server mode of BS structure. The cloud platform to be developed has the following functions: creating a new project, managing the project, safety production inspection, production and exporting report, record query and user management. The preliminary design of the functional framework is shown in Figure 4:

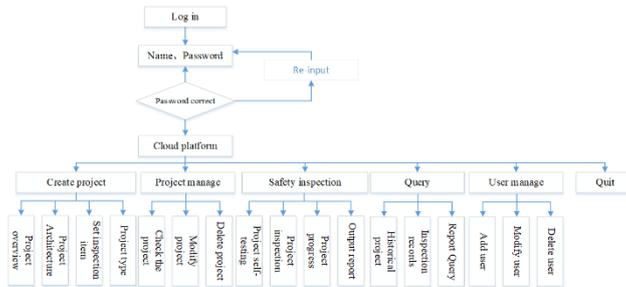


Fig. 4 System function block diagram of cloud platform

3.3 Expected Function of the System

See Table 1 for the overall expected function of the system. The system will be put into the safety production inspection of building construction, replacing the manual paper safety production inspection mode adopted at the present stage, reducing the work intensity of inspection personnel, enhancing the level of inspection personnel in troubleshooting hidden dangers, raising the real-time of inspection result reporting, improving the information level of production safety management and saving the management cost for the company.

4. System Function Implementation

4.1 System Main Interface

The main interface of the system is the main platform for man-machine interaction. The design of the main interface should adhere to the principles of conciseness, easy-to-use and complete functions, so that the users of the system can learn about the functions of the system at one glance and quickly complete the operation of safety production inspection during the process of using the system.

The main interface of the cloud platform is to realize login and operation on the computer. In order to facilitate the unification of the system and user operation, the interface design of the cloud platform is consistent with that of the mobile phone client. See Figure 5 for the login interface of the cloud platform.



Fig. 5 Cloud platform login interface

The security inspection personnel input the account password for verification to log in the function interface of the security management cloud platform system as shown in Figure 6.



Fig. 6 Cloud platform system function interface

The main function module of the security inspection system cloud platform is basically consistent with that of the mobile phone clients, so that the security inspection data of the mobile phone clients can be saved on the cloud platform, on the one hand, the storage space of the mobile phone of the clients can be released, and on the other hand, the remote view of the security inspection record and report can be facilitated.

4.2 Implementation of Safety Production Inspection Function

4.2.1 Safety Production Inspection Function

Safety inspection function is the main function of safety production inspection. Through the function of this module, the system needs to complete the self-inspection of engineering safety manager and the inspection of engineering safety.

4.2.2 Safety Inspection System Report

See Figure 7 for the report interface of the safety inspection, which is converted from the original manual inspection report to the electronic version report to facilitate recording and storage. In the mobile phone clients and the cloud platform, the report in word format can be exported, and in the mobile phone client, the report can be synchronously loaded to the cloud platform through the upload button. In addition, the report can be found according to the date in the mobile phone clients, after receiving the query request of the mobile phone client, SQL database of the cloud platform will send the historical inspection reports to the mobile clients on the cloud platform for viewing by the users.

In addition, the system can set up a new project or modify the old projects according to the user's demand. At the same time, the system management module is used to set the user authority.



Fig. 7 Security Inspection System Report

5. Conclusion

For the problems existing in the course of safety production inspection management in building construction, this paper puts forward the goal of improving information management level and improving management efficiency by using computer internet technology. This study adopts Java language to construct mobile phone client platform and adopts J2EE + SQL Server mode to construct cloud platform, so as to upload and download data through network and realize real-time sharing of safety production inspection data. The main work and significance of this study are as follows:

- (1) This study scientifically analyzes the present situation of China's building industry and the problems existing in safety production management.
- (2) Based on the analysis of related computer internet technology, this study designs the function requirements and function modules of mobile phone client and cloud platform of the system in detail, and the whole framework of safety production inspection system is constructed.

Table 1. Overall expected function of the system

Service object	Expected function
Production management department	Conduct self-inspection of the projects managed by the department
Project personnel	Conduct self-inspection on the safety production of this project
Safety management department	Implement safety inspection of the project, and rectify the situation of non-conformity with safety production, with the results verified by the safety officer on whether the rectification is qualified or not, and if it is qualified, form a record; if not, the rectification is reorganized once again.
Leader in charge	Carry out random inspection on project safety and check the inspection of safety personnel
Safety production inspection manager	Query inspection record, generate inspection report, export word-version inspection report

- (3) The development of the system has effectively changed the shortcomings of traditional safety production inspection data such as redundancy, difficulty in finding and poor timeliness, and provided effective support for construction safety management.

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