Design and Development of Energy-saving Scheduling System for Forging Production

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ABSTRACT

This paper is aimed at the development of energy-saving scheduling optimization system for forging production. The system uses Java language programming and make use of MVC (Model View Controller) mode to build the structure and utilize B/S (Browser/Server) network structure model for development of web client. The scheduling system combined with the equipment production capacity and forging processing parameters to optimize the scheduling task is aimed to achieve the optimal configuration between forgings and equipment to reduce or even eliminate the heating, forging waiting to help enterprises to achieve energy conservation.  

KEYWORDS

Java, Forging, Scheduling System, Enemy-saving and Emissions-reduction

INTRODUCTION

Based on the existing research on the forging furnace heating and forging scheduling optimization, the auxiliary software system development is carried out to facilitate the continuous production planning and scheduling work. The software system in function to achieve equipment capacity management in the forging production, forging information management, production planning tracking to schedule and optimize the production plan according to various types of information.

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The system development is designed from four levels, including the presentation layer, functional layer, interface layer, and data layer, it uses the Java language and other related scripting language to program development, and then use Mysql database for data layer support to achieve web client applications development.

SYSTEM ARCHITECTURE AND ENVIRONMENT CONFIGURATION

System Architecture

The MVC design mode is used to build the whole system. MVC is called Model View Controller. The architecture of the system is divided into the basic model layer, the view layer and the controller layer. The system uses b/s (Browser/Server, browser/server) network structure mode, so based on the IE browser, web browser which is used as united client is developed. The system is mainly designed from four aspects: the presentation layer, functional layer, interface layer and data layer, and the main contents are shown in Figure 1:

1) Presentation Layer: The presentation layer is the user interface layer that can be seen directly by the user. The system adopts the B/S mode based on IE browser to unify the client in the form of web interface to support the updating of the system version and facilitate the addition of the later system function.

2) Functional Layer: Functional layer is the system function module design. It means the system needs to achieve all the functions, including the management of machine, forging management, production planning management, scheduling management and energy monitoring and other functions.

3) Interface Layer: The interface layer provides all kinds of software interfaces and hardware environments for system operation, including computer operating system, network system, software interface, data request processing.

4) Data Layer: The data layer contains all the data used in the system, which is the level of data storage and reading and writing in the background. The database comprises the machine data table, the forging data table, the energy consumption data table, the production plan data table, the scheduling data table.
Development Technology And Environment

Development technology

The backend of system uses Java language programming, the front uses jsp, JavaScript, html, css and other scripting language. Database used Mysql; System development utilizes sshframe work,(spring + Struts2 + hibernate4.0); IDE of system development used eclipse, and database operation takes advantage of the HeidiSQL. When developing system, the connection of system and the database is not directly used JDBC technology, but is used the persistence layer framework—hibernate4.0.

The hibernate framework has the following advantages:
1) Encapsulatingjdbc and simplifying a lot of repetitive codes.
2) Simplifying the DAO layer coding work and the development makes more targeted.
3) Good portability and support a variety of databases, if you want to change the database, as long as changing the configuration in the file, while not replacing the hibernate code.
4) Supporting transparent persistence, because hibernate operation is pure (pojo) java class, no invasion and it does not achieve any interface. From this aspect, it's a lightweight framework.

The schematic diagram of the ssh frame is shown in Figure 2:
Development environment
Based on Windows system, the system is developed, and the tomcat7.0 web is taken as server, Java compiler environment is for jdk6.0; and java is configured with conventional variables.
SYSTEM FUNCTION MODULE

Modulecom Position

The main functional modules for energy-saving forging production scheduling system are divided into six parts: equipment management, forging management, production planning management, scheduling management, energy-consumption management and user management. The details are shown on in Figure 3 below:

Device Management Module

Device management module is mainly to achieve the classification of equipment and increase, delete, change, check operation about equipment information, and query the status of the equipment. The type of equipment is divided into four categories: heating furnace equipment, forging equipment, quenching furnace equipment, and tempering furnace equipment; the device information includes device’s type, number, parameter, and quantity of device; the status of the device is divided into stagnation and running status.

Forging Management Module

Forging management module contains forging of the increase, delete, change, check, forging the cluster, and query the forging the processing status. Forging information includes the type, shape and size of forgings. Forging the processing state is divided into nine parts: to be heating, heating, to be forged, forged, to be quenched, quenched, to be tempered, tempered and finishing forging.

Production Planning Management Module

The production plan management module contains the tasks of the addition and query, the task of the scheduling results query. The task query information contains the general task and local task. The task contains information such as the start and end time, the task execution status (executing, pending and pausing execution), task manager and task executor. Task scheduling results are divided into furnace scheduling results, forging scheduling results, quenching scheduling results and tempering scheduling results.

Scheduling Management Module

Scheduling management module includes heating furnace scheduling management, forging scheduling management, heat treatment scheduling management. For furnace scheduling management, the forging of the furnace heating is clustered, combined, and then accomplished. For forging scheduling management, the forging which is to be forged will match energy consumption and equipment, and then keep a connection with the quenching process to generate forging task in equipment. Heat treatment scheduling management is divided into quenching scheduling and tempering scheduling. Forging automatically generates quenching task in the process of forging, and the tempering task is autonomously completed after finishing quenching.
Energy- consumption Detection Module

Energy consumption detection module is to achieve the energy consumption monitoring and control in the entire forging process, including the energy consumption change in heating furnace, forging, and heat treatment. According to energy consumption, analysis and control are calculated to provide visual control panel for energy-saving, and then feedback implementation of energy-saving scheduling model.

User Management Module

User management module contains administrator and ordinary users, administrators’ permissions are different from the ordinary users. The ordinary user's operation has registered users, login system and operation scheduling module to view other modules; while administrator users can delete and view the ordinary users as well as possessing other permissions of ordinary users.
Module Logical Relationship

The main purpose of the system is to achieve scheduling operations in the forging production, all the scheduling is based on the established process and site conditions, and all aspects of the scheduling are interconnected with each other. In this paper, the main research is the scheduling of forging in the process of the heating, forging, and heating treatment. Heat treatment process scheduling is based on the forging link scheduling, forging link scheduling is based on the heating link scheduling, if out of the previous link of the scheduling, the actual use of the entire scheduling is low. For the design of the scheduling system module in this chapter, the logical relationship among the modules is shown in Figure 4:

![Function flow chart of energy saving scheduling system for forging production](image)

Figure 4. Function flow chart of energy saving scheduling system for forging production.
SYSTEM FUNCTION DEMONSTRATION

The success of system design and development realizes the above module function. The equipment management module and the forging management module include all kinds of detailed information about the equipment and forgings, and can support the addition and deletion of information. Details of the system modules are shown in Figures 6 and 7 below:

Figure 6. Detail information of device.

Figure 7. Detail information of forgings.
In the scheduling management module, according to the forging information and equipment production capacity, the production tasks are to optimize scheduling. The module includes the heating, forging, quenching and the tempering scheduling of the forging. The system can generate the scheduling result according to the selected forgings and equipment. The target function value of the relevant scheduling is displayed in the scheduling result table, and then scheduling files are generated. The scheduling file can be viewed or downloaded, as shown in Figure 8 below. After the production task scheduling is completed, the production planning module number each work task and assign the assignment to the operator.

![Scheduling](image)

Figure 8. Interface of scheduling.

**CONCLUSIONS**

From the perspective of process optimization and the Java, the scheduling system which is combined with the existing scheduling research results is developed. The scheduling system can allocate tasks among any selected forgings and equipment, and quickly generate optimal task allocation plan. It can reduce heating and forging waiting, and effectively help enterprises to achieve energy saving and emission reduction.

**REFERENCES**


