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MES system based on intelligent manufacturing platform

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Abstract

With the research and application of industry 4.0, industrial Internet and intelligent manufacturing in China becoming more and more extensive, domestic small and medium-sized manufacturing enterprises are paying more and more attention to information work. The purpose of this paper is to research and develop the corresponding MES app for the intelligent manufacturing experimental platform, so as to effectively realize the operation and management functions such as remote mobile control and monitoring of the intelligent manufacturing experimental platform.

Keywords

MES system,Intelligent Manufacturing, Industry 4.0.

1. Introduction

With the research and application of Industry 4.0, Industrial Internet and Smart Manufacturing becoming more and more widespread in China. Domestic small and medium-sized manufacturing enterprises are paying more and more attention to informatization work. Advanced management ideas and management systems have been introduced to small and medium-sized enterprises one after another, including planning management systems represented by MRP, MRPII and ERP and industrial control systems represented by DNC, PLC and SCADA. These systems serve the enterprises well. However, the planning management system does not extend to the bottom control system, and the bottom control system does not extend up to the planning level. As a result, there are "information islands" at the planning and control levels, and the plans made by the enterprise are not accurately executed. It is clear that the planning management system does not have real-time access to site data when making plans, resulting in a lack of analysis of site conditions when making plans. When the internal and external environment of the company changes, the production site also cannot get timely instructions to make adjustments. To address that issue, it can be found that the lack of effective communication and integration between the planning and control levels is the real reason for the disconnect between planning and production. This disconnect is not conducive to improving the market competitiveness of enterprises. The development of information technology has enabled companies to discover that Manufacturing Execution Systems (MES) can solve the disconnect between the two phenomena and achieve two-way communication between the upper and lower levels, thus realizing a continuous flow of information in the enterprise.

2. Overall System Scheme

The MES system can integrate the upper ERP system and the bottom FMS system, and can realize the real-time monitoring of the bottom equipment. Its overall framework is shown in the figure.

(1) The planning layer is mainly for production planning, which includes ERP/ MRPII and other upper management systems, providing various production information, such as material, product and human resources information.

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(2) The execution layer is realized by the MES system. The main functions of the MES system and app are order management, material management, equipment management, quality management, process management, data management and backup management, etc.

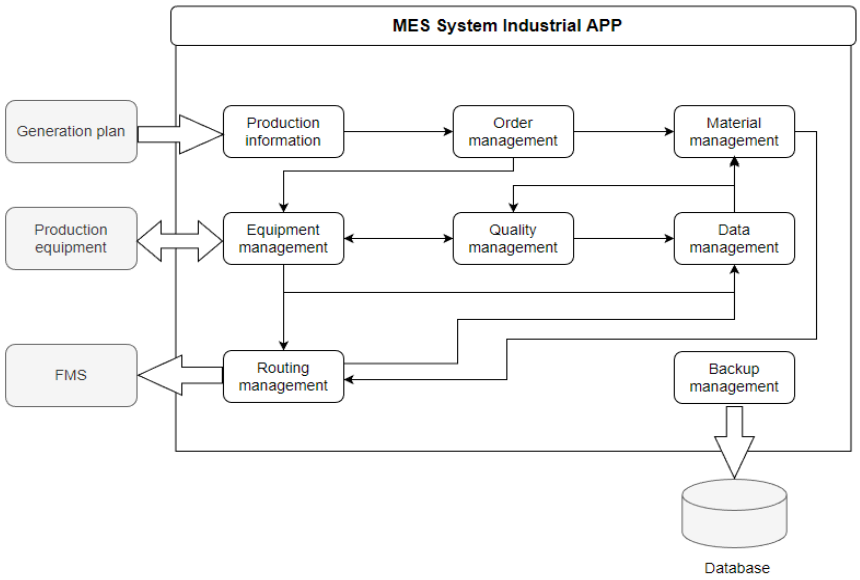

Figure 1 System Architecture

(3) The control layer mainly realizes the feedback of equipment status and the collection and storage of production data through production scheduling.

As can be seen from the figure, the MES and APP system for the intelligent manufacturing experimental platform integrates the order management of the planning layer. And the MES is more convenient and fast to understand the specific details of the order and realize the real-time monitoring of the order execution. The MES system also realizes the supervision of the underlying equipment and the control of the production process through the interaction with the FMS system. The MES system fully plays its role as an execution layer.

3. Software Framework Technology

The MES system of the intelligent manufacturing experiment platform adopts the B/S architecture model, which can realize multi-user off-site access and control. The software application framework technology module used in the system is shown in the figure.

MES system software framework uses SSH framework technology (Spring framework + Structs framework + Hibernate framework). The framework separates the user interface, business logic and data processing, reduces the redundancy and coupling between the various levels, and can improve the scalability of the MES system. The MES system is divided into three layers: Web layer, business logic layer and data layer according to the features of the SSH framework.

The Web layer is a user interface layer that provides a visual interface for users to operate, and uses the Structs framework to manage the logic between pages and provides control classes (Action classes) to handle data transfer between pages and between pages and businesses. Web layer pages are written in JSP language jsp pages, and the internal logic of the page itself is implemented in JavaScript (Jqurey class and Ajax technology, etc.) scripting language and HTML language, etc.

The business logic layer is the background to the page data processing layer, which includes service, data access objects (DAO) and simple Java objects (POJO). The way in which the Service class for Structs framework control class (Action class) to provide business logic is the Web layer to pass data to the database interface. Data Access Object (DAO) provides data for the operation methods of the Service class to add, delete, change and check etc. Simple Java objects

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(POJO) are the objects that DAO and Service classes operate on. They map the tables in the database one by one into POJO objects, so that the operations of DAO and Service classes on the database are converted into operations on POJO objects.

The data layer is using the Hibernate framework, which implements connections to the database server and encapsulates methods for database operations that can be accessed by DAOs.

Spring framework is a comprehensive integration framework, mainly the above three levels of the overall configuration and integration. It can achieve the integration of each sub-framework, and the independence of the sub-frameworks. It makes the three levels of MES system software work together better.

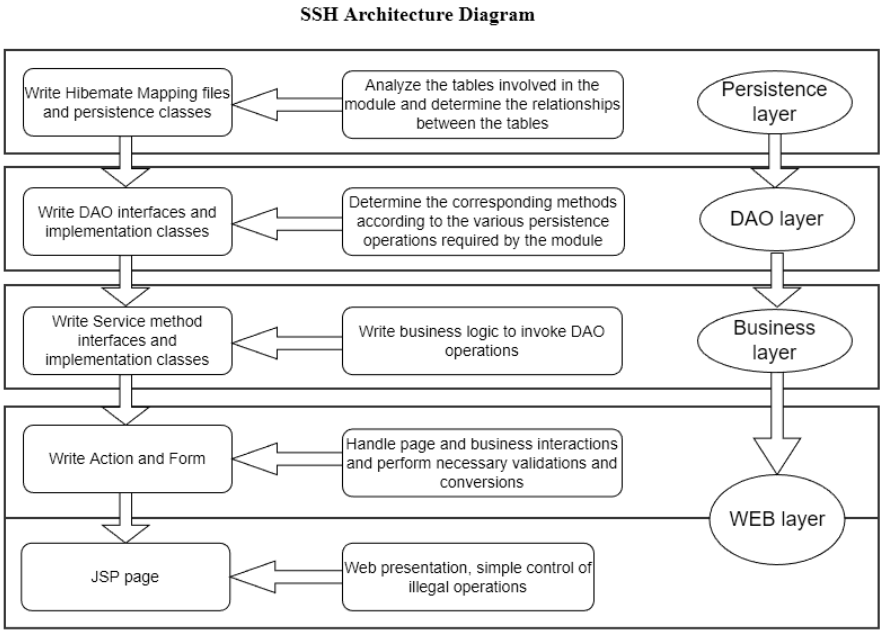

Figure 2 System Framework

4. Functional Description

As a bridge between the upper planning layer and the bottom control layer, the MES system and app play a pivotal role in the control of the manufacturing process. Based on the characteristics of the intelligent manufacturing experimental platform, the MES app function module is designed and implemented.

Intelligent manufacturing experimental platform is characterized by the full workflow of unmanned and real-time feedback production status and equipment status. It only requires the issuance of specific production instructions, and the intelligent manufacturing experimental platform can be manufactured. According to its characteristics, it is determined that the MES system design objectives are to analyze customer orders, allocate resources such as materials and equipment, and design process flows. Therefore, the MES system functions are designed into eight modules, as shown in the figure.

1) Basic Information Module. It is mainly composed of four sub-modules: personnel management, role management, permission management and password management. Personnel management sub-module realizes the management of personnel information, including adding, deleting and modifying personnel information.

2) Order management module. The order management module is mainly used to analyze the product information attached to the order information and find the material and equipment information needed for the product.

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3) Equipment management module. There are three main sub-modules: equipment code management, machine tool management and AGV management. The equipment code management sub-module mainly realizes equipment code unification with the underlying FMS scheduling software to facilitate equipment scheduling and management, as well as feedback on specific equipment information. The machine tool management sub-module mainly realizes the status monitoring of CNC milling machine information. The purpose of the AGV management sub-module is to implement RFID (Radio Frequency Identification) information feedback to track the product production process, etc.

4) Material Management Module. It is mainly composed of four sub-modules: material information, warehouse information, product information and BOM table. The material information sub-module stores the detailed information of materials, including material number, material name, material quantity and supplier, etc. The Warehouse Information sub-module determines the location of the products in the warehouse and the location of the materials to be picked. The Product Information sub-module describes the product-specific information. And the BOM table is the generation of the product bill of materials, etc.

5) Process management module. It is mainly composed of three sub-modules: process flow, process card and SOP. The three sub-modules mainly realize the design of the product generation process and refine the process information so that it can be distributed to the scheduling software FMS to carry out the production in an orderly manner. The process management is the core function module of the intelligent manufacturing experience platform.

6) Quality management module. It mainly includes the quality monitoring module during the production process and the report analysis after the production to realize the monitoring and analysis of the failure in the production.

7) Data management and backup management module. It mainly realizes the unified management of the data used in production, and can realize the backup function of some important data.

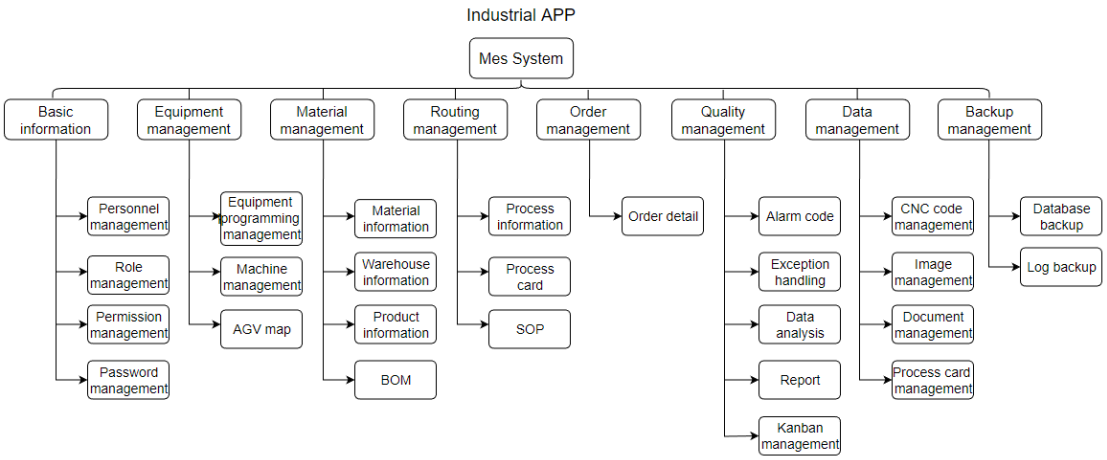

Figure3 System Function Module

5. Software Details

As Android system development can freely customize the operation interface, Android operating system is easier to get started and more intelligent as well. Therefore, we chose the Android platform to obtain various data. In terms of data statistics, various data are presented in the form of charts and graphs, which can be more intuitive to observe the real-time changes of data.

Functions such as intelligent procurement, production line arrangement, customized production, production line creation, and sales report statistics have been completed.

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Corresponding production lines can be created to produce vehicles according to needs, and the durability of each step of the production line can be viewed in real time. When the durability is too poor, the alarm will be given. Smart Procurement enables the purchase of parts based on reasonable prices. Vehicle customization can customize parts to produce vehicles according to the needs of customers and can deploy every employee.

6. Conclusion

As the execution layer between the planning layer and the control layer, the MES system is responsible for managing workshop production and executing planning and scheduling. The manufacturing execution system provides workshop management and control functions on a unified integrated platform, effectively improving the workshop management capabilities of enterprises. Manufacturing execution system improves manufacturing competitiveness by controlling all workshop resources including materials, equipment, personnel, process instructions and facilities, and integrates related functions such as material management, quality management, document management and production scheduling on a unified platform. The function of the manufacturing execution system fully solves the contradiction between the planning layer and the control layer, and makes full use of the data between the upper and lower layers to improve the real-time and flexibility of the plan. And at the same time, it also improves the operation efficiency of the production line.

The purpose of this project is to research and develop the corresponding MES app system for the intelligent manufacturing experimental platform, so as to effectively realize the operation and management functions of remote mobile control and monitoring of the intelligent manufacturing experimental platform.

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