

# Research and Development of Manufacturing Management System

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**Abstract:** MES system is an integrated information system integrating multiple functional modules, which is used to manage and monitor the production process and improve the production efficiency and quality. With the rapid development of the manufacturing industry, the manufacturing management system (MES) has become a key technology to improve the production efficiency and product quality of the manufacturing enterprises. In this paper, we deeply study and discuss the key technology and application of MES system. Through the design of the physical layer and software layer architecture of the MES system, including the overall system structure, database, functional module, system integration, etc., the development of the manufacturing management system (MES) is realized.

**Keywords:** Internet of Things, Digitization, Mes system.

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## 1. Introduction

In recent years, with the accelerating trend of global economic integration and the deep integration of industrialization and information technology, China's manufacturing industry is experiencing profound changes. Manufacturing enterprises have realized that the traditional manufacturing has been difficult to meet the market demand in the future, must be combined with modern intelligent technology, to digital, networked, intelligent transformation, is the way of manufacturing quality development, only comprehensive improve their manufacturing level and constantly reduce their production cost is the only way to manufacturing enterprises.

As a big manufacturing country, China's national economy will rely on the pillar industry of manufacturing for a long time. With the acceleration of economic globalization, the manufacturing industry has entered the era of global development, the enterprise competitors expand to the world, and the market competition is increasingly fierce. At the same time, the rapid and changeable market demand will further shorten the product manufacturing cycle, customers' demand for customized products is becoming more and more obvious, the production form presents a small batch and multiple types of pattern, the requirements for manufacturing enterprises are far higher than a few years ago. In terms of enterprises, how to make the production steady and orderly under the condition of diversified production and personalized product design, while maintaining certain production flexibility and agility to the market, and how to strive to the top in the highly challenging economic era are the problems that enterprises need to think about.

Shen Huagang et al. used PHP language, MySQL database, PhpStorm and other development tools to develop the intelligent casting production management system, to realize the visualization and rapid statistics of the casting production process, and effectively improve the efficiency and quality control of the casting production process[1]. Li Shusheng proposed the production management system for the gold jewelry weaving chain factory. The real-time monitoring of production equipment is realized by collecting the operation

status data of production equipment, scanning orders, operators and production equipment, binding the production relationship of operators[2]. Li Yuan et al. designed the manufacturing information management manufacturing execution system (MES) based on the execution layer of the workshop of manufacturing enterprises, where users can remotely monitor the working status of the field equipment through the PC browser[3]. In order to solve the problems existing in the production process of the electronic manufacturing industry, Liu Wenya designed a production management system, which is based on the Java language for front-end development [4]. Wang Yihang made theoretical analysis and case explanation for the scheduling problem in the workshop, and by comparing several heuristic algorithms and genetic algorithm, generated the initial solution of the heuristic algorithm[5]. Ding Xiaoping proposed an intelligent production management system of dual-block sleeper based on B / S architecture[6].

As the information intersection center of personnel, materials and equipment, the production management of the manufacturing workshop has always been the key and difficult point of enterprise management. On the one hand, the workshop production scheduling needs to consider the process, equipment, delivery time and other factors, to develop a compact and efficient production operation plan is relatively difficult. Workshop inside, on the other hand, there is a multifarious material flow and information flow, workshop production line and the relevant production department has complex business coordination relationship, the improvement of production plan efficiency is also a difficulty, and workshop manufacturing execution system the underlying workshop production site and enterprise upper management platform effectively, by building a highly integrated and intelligent information management platform, make the traditional production transparency, fill the production site to the "information" gap between planning system. Optimize the production management mode, strengthen the office capacity of all departments, real-time control of production process control, improve the execution of factory manufacturing.

## 2. Research Content

Through the field research of the enterprise, it is found that although the enterprise has ERP system, the ERP system is biased to the management of the overall resources of the enterprise, so the enterprise leads to lack the control of the manufacturing process of the workshop, unable to control the consistency of production scheduling, the real-time of production schedule, and the safety of abnormal production problems.

The production department is the largest department of the factory, so it should pay attention to production management, timely control and analyze the production and processing process of the production workshop, monitor the status of production equipment in real time, eliminate and sprout abnormal problems in the production process, and improve the management means of enterprise informatization.

Through the design of a manufacturing management system, the equipment operation information, product tracking, quality control, equipment fault analysis, and other functions, to provide timely and accurate information, make enterprise timely according to the change of internal resources

and external demand to adjust production, help enterprises to reduce costs, timely delivery, improve product quality and service quality, improve the core competitiveness of the enterprise, make the enterprise healthy and sustainable development.

## 3. System Architecture Design

The physical layer structure can be divided into two layers: the hardware collector layer and the data collector server layer, as shown in Figure 1. The functions of each layer are described as follows:

### (1) Hardware collector layer

This layer is mainly bound with the workshop equipment to detect the operation status, output and operation data of the equipment in real time, and regularly send it to the message processing platform- -MQTT.

### (2) Data acquisition server layer

This layer mainly detects that the hardware collector is uploaded to the message processing platform- -MQTT device data, processes and encapsulates the data, and stores it in the database.

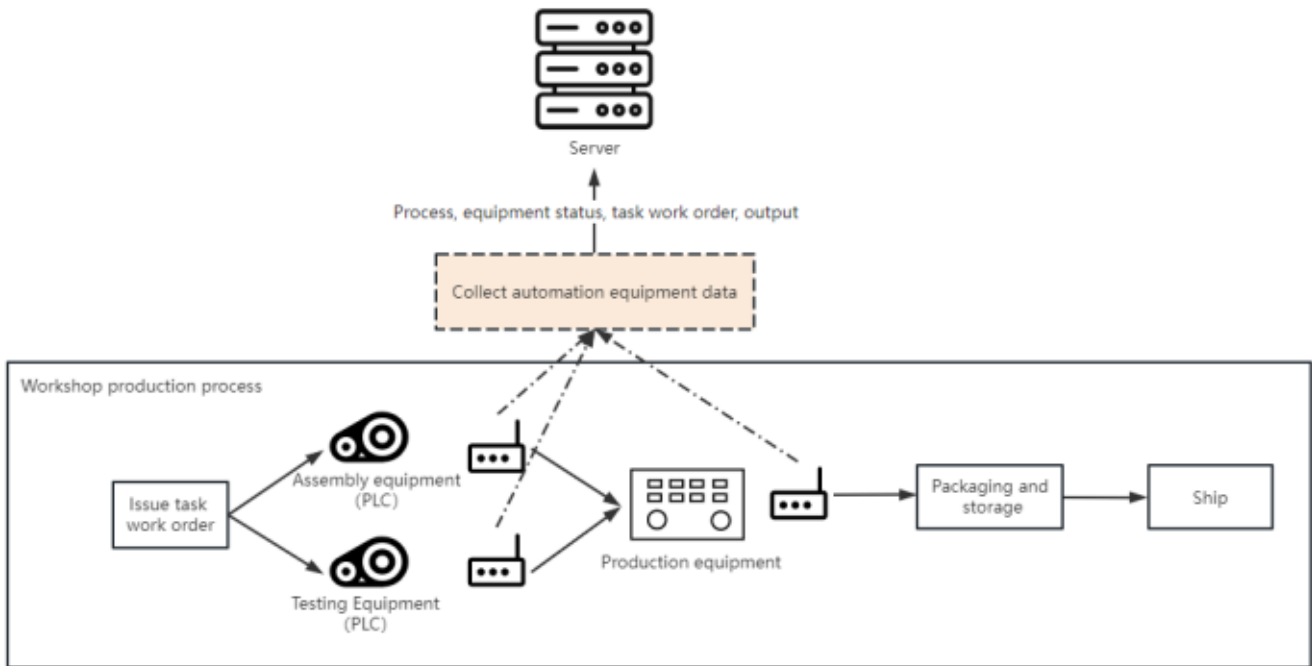


Figure 1. Design of the physical layer architecture

The system software adopts B / S architecture, B / S architecture is browser / server, and C / S architecture is client / server. Compared with C / S architecture, B / S architecture has the advantages of simple installation and maintenance, light load and high mobility. Users can operate with the browser, which is very suitable for the development of the system of this project.

The system architecture design is separated from four layers: data storage layer, data access layer, business logic layer and user interface layer, as shown in Figure 2. The functions of each layer are described as follows:

### (1) Data storage layer

This layer is mainly responsible for the storage of the data. The database stores a large amount of information, including user information, key equipment ledger information, status information, operation information, fault maintenance

information, etc.

### (2) Data access layer

This layer mainly provides access to the data storage layer. Database access class and database communication with each other, mainly including functions including database table service, data management, concurrent processing and other functions. Finally, the data interaction between all the data and the upper business logic layer is realized through the data entity class.

### (3) Business logic layer

This layer is mainly responsible for the conversion and processing of the data. First receives the user request from the interface layer, then performs the request processing data and calls the data access layer, and finally feedback the execution processing results to the user interface layer display. The business logic layer is between the user interface layer and the

data access layer, which plays a role between the preceding and the following in data exchange.

(4) User interface layer

This layer produces direct interaction with the user, mainly by presenting the system interface to the user and displaying

the user operation request after processing. The user interface layer of the device manufacturing system is a browser based on the WEB server, and the user makes a request in the browser interface, which is executed by the business logic layer and returns to the interface to display.

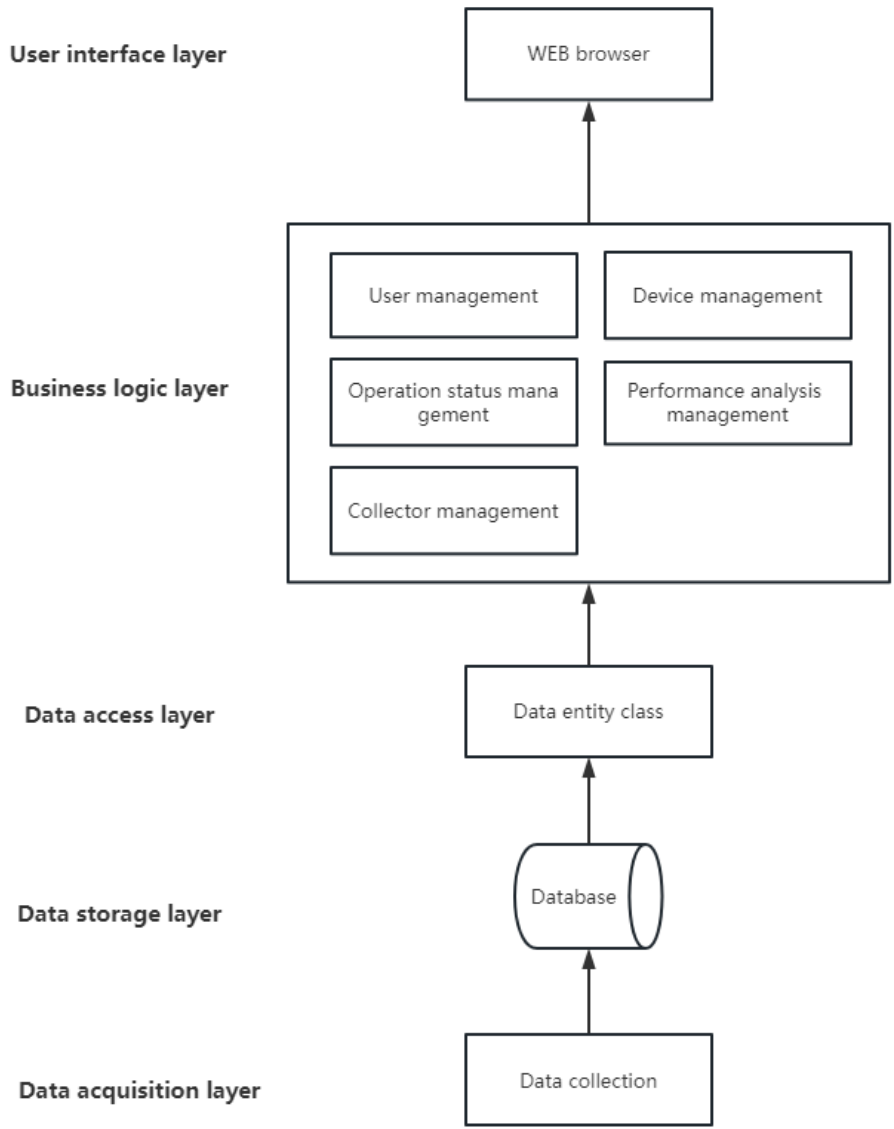


Figure 2. Software architecture diagram

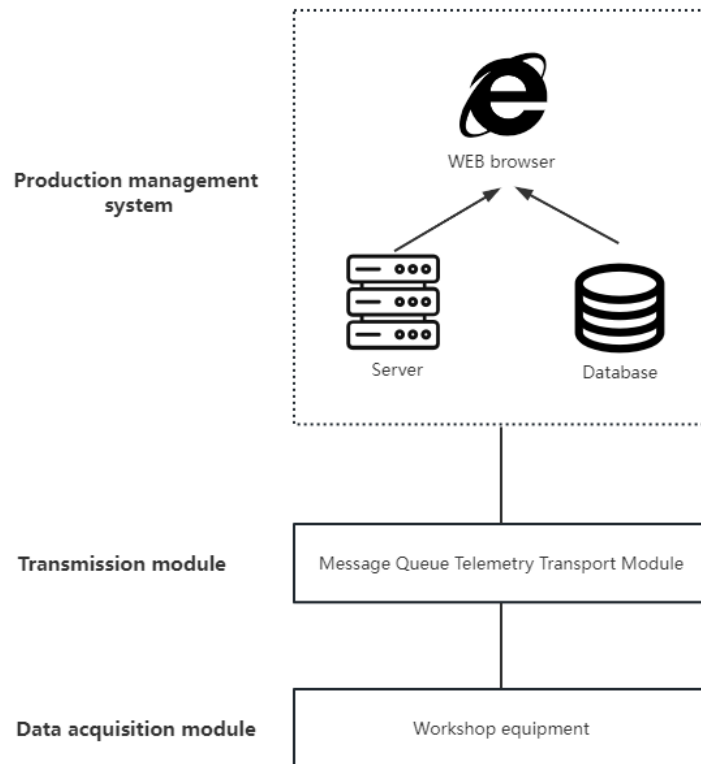
## 4. System Design

### 4.1. system design scheme

In view of the existing problems in the management of the key equipment, the design scheme based on the equipment manufacturing management system is proposed. The system consists of three parts: data acquisition module, message queue telemetry transmission module (MQTT) and equipment manufacturing management software platform.

Among them, the data acquisition module mainly realizes the collection of the operation data in the production workshop and the equipment. The message queue telemetry

transmission module mainly completes the data transfer between the acquisition module and the software platform. Equipment manufacturing management software platform mainly complete the data storage and further processing analysis, through JAVA technology to the software system of logic performance analysis of equipment, using VUE technology to complete the design and implementation of the user page, in the WEB browser display system interface, to the equipment status monitoring and equipment performance management, improve equipment utilization and enterprise production efficiency. The overall frame structure of the system is shown in Figure Figure 3.



**Figure 3.** Architecture diagram of the system

## 4.2. System functional module design

The software system adopts modular design, which is mainly divided into five functional modules: data acquisition module, user management module, equipment and collector management module, equipment operation state monitoring module, and equipment performance analysis module.

## 4.3. Data acquisition and management module

The function of this module is to collect data. The collector monitors the operation data of the equipment in real time, uploads it to the message queue telemetry transmission module (MQTT), and collects the data collection server for packaging and processing, analysis and storage.

## 4.4. User management module

This module is divided into two sub-modules: user rights management and user information management:

### (1) User information management module

The user information management module mainly realizes the query, increase, modify, delete and assign roles of the user basic information.

### (2) User rights management

User Rights management is to assign user rights to roles in this system, which can increase, delete, modify, and reassign permissions in a role.

## 4.5. Management of equipment and collector

The module is mainly divided into three sub-modules: device ledger management, collector ledger management and device binding collector management:

### (1) Equipment ledger management

Equipment ledger management mainly realizes the inquiry and modification of the production equipment ledger information and the deletion of new equipment and useless equipment.

### (2) Collector ledger management

Collector ledger management mainly realizes the query and modification of the collector ledger information and the deletion of new and discarded collectors.

### (3) Device binding and collector management

Equipment binding collector management mainly realizes the query of the mutual binding relationship between equipment and collector in the workshop, including adding, modifying and deleting.

## 4.6. Monitoring and management of equipment operation status

This module is divided into two sub-modules: real-time state monitoring management and historical state query management:

### (1) Real-time state monitoring and management

It mainly realizes the real-time operation status query of the equipment, which can be inquired through the equipment number, name or workshop and other information.

### (2) Historical state query and management

It mainly realizes the record query of the equipment history status change, which can be query through the equipment information.

## 4.7. Equipment performance analysis and management

This module is mainly Kanban module, which is divided into two sub-modules: equipment output management and equipment operation time monitoring and management:

### (1) Equipment output management

It mainly realizes the statistical query of the equipment output and the equipment capacity analysis, which can be inquired through the time period and the basic information of the equipment, and also exports to generate reports.

### (2) Monitoring and management of equipment operation

time

It mainly realizes the statistical query of the equipment running time, standby time, fault time and equipment utilization rate, which can be queried through the time period and the basic information of the equipment, and can also be exported to generate reports.

#### 4.8. Design of the system database

The equipment status data of the manufacturing workshop is characterized by real-time, massive and multi-source. Compared with the data of other industries, the storage of the workshop production data has more important significance. The main function of the system is to realize the monitoring of the equipment operation status and the management of the equipment performance analysis. The completion of the above system functions requires the support of a large number of monitoring data. The main function of the database is to save the monitoring data and complete the real-time interaction with the software system. The design of the database is closely related to the design of the software functional module of the system. According to the functional modules of the system, the database should be able to store the basic user information, role information, equipment ledger information, collector ledger information, equipment binding collector information, equipment real-time status information, equipment output information, etc., combined with the current characteristics of equipment data, build the database ER model, and complete the design of the database table.

### 5. Conclusion

This paper designs and implements a set of manufacturing management system (MES) according to the problems and requirements in enterprise production management. Through the physical layer and software layer architecture design of the system, the integration of multiple functional modules such as data collection, equipment management, equipment

monitoring and performance analysis is realized, and then the comprehensive monitoring and management of the production process is realized. This paper also describes the importance and advantages of the MES system, including improved production efficiency, cost reduction, improved production quality and traceability. In practical application, MES system has brought significant benefits and value to enterprises, effectively improved the production efficiency and management level, and improved the market competitiveness and profitability of enterprises.

### Acknowledgment

This work was supported by basic Scientific Research Project of Wenzhou Excellent Key Laboratory (Engineering Technology Research Center): H2020012

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