

Design of web-based visualization system for production information

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Abstract

Aiming at the problems of complex data information structure, poor man-machine interface interaction effect and lack of remote transmission collaborative management function in manufacturing quality management system. Taking the large part production line of door machining center as the research object, a remote visual quality management scheme based on Web technology is proposed. The data visualization technology, separated development technology, modularization technology and cloud remote deployment are integrated into the quality management system to realize remote visual quality management. The real-time release, feedback and view of the field data information of the production line are realized through the browser equipment, so as to improve the quality management efficiency of the large parts production line of Longmen machining center.

Keywords

Web technology; Production line, Data visualization; Remote transmission; Quality management.

1. Introduction

The in-depth integration of Internet technology and manufacturing industry brings opportunities for industrial transformation. The "Made in China 2025" manufacturing power strategy clearly proposes to change the existing management and competition models and promote the intelligent upgrading and transformation of enterprises.

Quality management plays an important role in the manufacturing process, and plays a decisive role in the quality of the product during the manufacturing process. ^[1] The quality management system helps companies improve the quality of their products and realize the upgrade and transformation of the quality management system, which is conducive to improving production efficiency. ^[2] In modern management methods, remote technology has been widely used, providing an important foundation for remote collaborative quality management, but in the manufacturing industry, it is mainly used in the remote file transmission stage, and remote collaborative management applications are scarce. The Graduate School of the Chinese Academy of Sciences developed a component-based remote visualization system based on the web to achieve a flexible development structure, easy implementation and maintenance, but not integrated with management methods. ^[3] Ren Xianlin and others used WEB service technology to remotely visualize the quality system remote audit system, and showed through examples that remote visual management has improved the level of enterprise quality management system and the function of remote collaboration ^[4].

In order to realize remote transmission and visual display of information and data, web technology is the mainstream technology for developing Internet applications. Web technology has become the mainstream solution for remote transmission problems in the industrial

Internet field. It takes the distributed application structure as the core and remotely transmits information through network connection to complete the task together^[5]. Web technology is applied to industrial software management systems. It has the characteristics of simple information transmission, separate development, easy system maintenance, and strong interaction. It is an effective means to solve the visual effects of quality management systems and remote information transmission.

Remote visualization is a new type of visualization technology developed to the Internet age. The remote visualization technology simplifies the terminal visualization software, and makes the available software and hardware resources on the network effectively used, which is of great significance^[6]. Due to the network environment, remote visualization technology has a hardware environment that traditional visualization technology does not have, including stronger storage capabilities and image processing capabilities.

Based on this, this article proposes a web-based remote visual quality management plan for the large-scale parts production line of a gantry machining center. The purpose is to display quality information and audit digitally and graphically, so that enterprise managers can simply and intuitively understand the production quality of the production line, And combined with web technology to enable the quality information of the production line to be displayed to managers and users in remote offices through remote transmission through the network. As shown in the figure, the information of the quality management system is stored in the corresponding database. The web client displays the interface for visualization and user interaction and data reception processing.

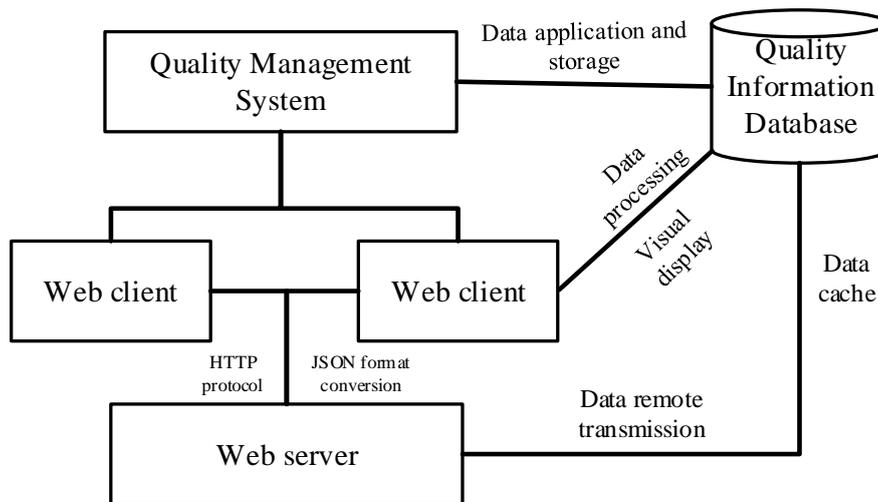


Figure 1. System framework

2. Large parts production line of gantry machining center

2.1. The composition of the production line

This production line completes the horizontal and vertical processing of large parts such as gantry machine bed, column and saddle. As shown in Figure 2, the production line is mainly composed of three production line processing units: saddle processing unit, column processing unit, and bed processing unit. In addition, it includes a large logistics line, an output logistics line, a logistics exchange trolley, and manual loading. The composition of the logistics area (a total of 9 CNC machine tools, 12 cache stations, 1 pallet exchange system, 2 logistics lines, and 1 FMS master control system) to realize the finishing and rough machining of large parts of more than 20 different specifications in 5 categories . The exchange trolley realizes the exchange and transportation between the workstations, and the entire manufacturing and logistics process generates a large amount of quality management data^[7].

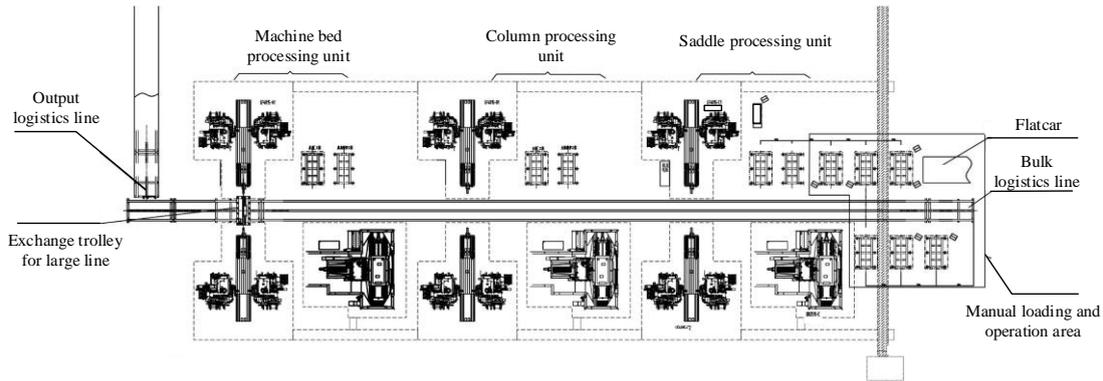


Figure 2. Production line layout

2.2. The quality management process of the production line

The quality management task dispatch of the production line is that the workshop planning management plans and dispatches the various quality inspection tasks of the entire production line according to the current production situation, and allocates and schedules the quality inspection tasks of the production line rationally through scheduling management. Corresponding to the issuance of tasks.

When the task dispatch is issued to the quality management, the staff member checks whether the dispatch is received. When it is not received, the information is fed back to the scheduling management system for secondary task dispatch and confirmation; when it is received, the quality inspection of the corresponding processed parts of the production line is completed according to the content of the dispatched task.

After the inspection, the staff needs to record each inspection task, record the completion of the tasks that have passed the quality inspection, and feed back the number of qualified products to the quality management system. For unqualified tasks, in addition to unqualified records and statistics on the number of unqualified products, the inspection tasks that cannot be accurately judged must also be sent to the special inspection department for feedback to the quality management system.

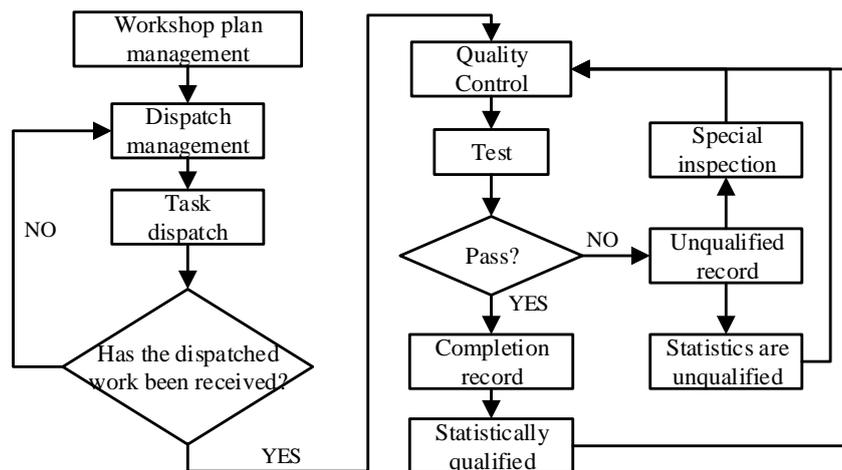


Figure 3. Quality management process

2.3. Quality inspection standard for large parts of gantry machining center

Quality inspection standards are one of the most critical parts of quality management. This production line regulates the inspection quality of large parts in gantry machining centers. Adding inspection standards to the management system can guide the staff in the part inspection tasks and historical inspection records. According to the GB/T 19362 and GB/T

17421.1-1998 standards, the geometric accuracy and work accuracy of the gantry machine tools for general purpose and general accuracy in the management system are specified. And the tolerance standard of axis positioning accuracy, and the machine tool axis is named according to JB/T 3051-1999. According to the actual processing application and tolerance requirements of the quality inspection of the production line, the inspection items and tolerance standards of the quality management system are established^[8].

3. Data visualization design and remote transmission deployment

3.1. Quality management data visualization process

Data visualization technology has changed the traditional quality management display method, so that managers can avoid the problem of ambiguity in the expression of complicated data tables, and simply and directly obtain the status of product quality inspection. This article classifies, modularizes and analyzes the quality management information and data generated by the quality inspection of the production line. Based on the management system data combined with mainstream data visualization solutions, the information and data are displayed in a chart style. The specific visualization process is shown in Figure 4.

Modularization of quality management procedures: The quality management of the large-scale parts production line of the gantry machining center is mainly composed of parts inspection tasks produced by each processing unit, unqualified inspection review, inspection history records, product quality inspection standards, and inspection task completion progress. According to the quality management composition structure and the logical relationship between each other, the quality information and data are structured, and the corresponding management module is set up.

Establish a database of detection information: determine the data structure between the system and each module through the business logic relationship of the management process, and establish a data structure model. For example, set the task number as the primary key to connect foreign keys such as detection standards, history records, detection statistics, etc., and you can query related foreign key content through the primary key.

JSON format conversion: To connect the content of the client and the database, write mysql language through the server node.js-mysql module query attribute to add, delete, modify, and query operations. The server uses the JSON.parse() method to convert the database JSON string into a JSON object and provides it to the client for data binding, and uses the JSON.stringify() method to convert the JSON object into a JSON string and transmit it back to the database.

Visualization of quality information: The client display interface combines Echart visualization technology to display the data information of the quality management system in the form of graphics and tables; at the same time, combined with the elementUI customer service terminal component library to optimize the interaction environment of the entire system. The client terminal binds to the data object information in JSON format through the relevant visual interface. The built-in dataset property of Echart combines the two-dimensional table, key-value and other data sources by setting the encode property to complete the mapping from the data information to the chart to realize the data Visualization ^[9].

The above process displays quality management data information in a data visualization manner, which not only directly displays the product quality of the production line in the form of charts, but also can be used cross-platform compatible.

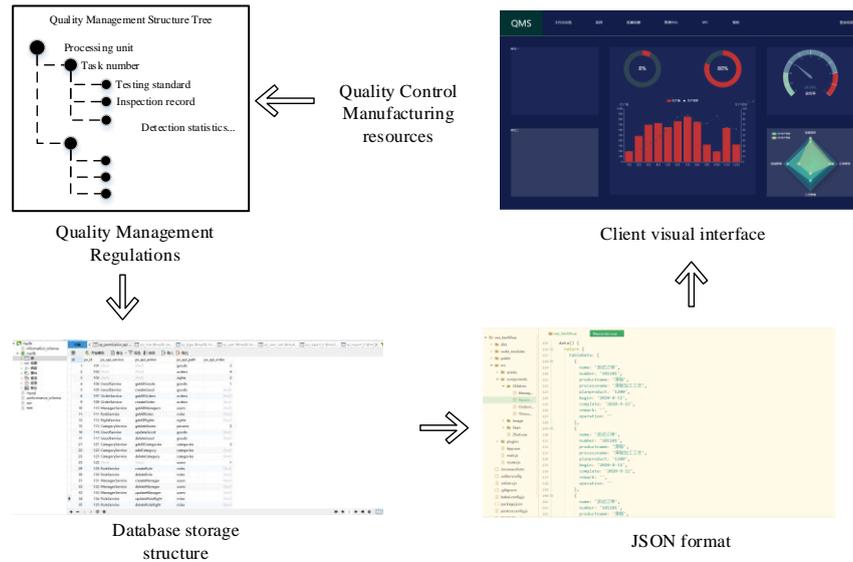


Figure 4. Visualization process

3.2. Cloud remote transmission deployment

Remote transmission is the core of the entire system model. After the management system completes data visualization, all resources cannot be accessed remotely. The access used by the quality management system can only be in a specific local area and cannot complete cross-domain office^[10]. This article addresses this issue by deploying all local development resources in the cloud.

Cloud-based remote transmission deployment: Import development resources into the cloud in a compressed package format, and decompress them in the cloud space. At the same time, deploy the client, server, and database related environments in the cloud space, and modify the performance of the debugging system according to the set domain name address. Specific operations include: add domain name access address; add rar package file, modify client routing address, remote access test, etc. At the same time, in order to ensure the management of the database and reduce the problem of database modification, the database is managed through the remote visualization function provided by the local Navicat for MySQL software.

The above process mainly realizes the quality management of a single factory with multiple suppliers in different places, multiple factories in a single enterprise park, a single enterprise with multiple factories in different places, a single enterprise with multiple outsourcing factories, and multiple factories, multiple outsourcing factories and multiple suppliers in different places.

4. Design and Implementation of Quality Management System

4.1. Separate development and modular design of system client and server

4.1.1 System separated design

In the separated application mode, the degree of coupling between the client and the server is relatively low, which reduces the mutual influence of development and maintenance between the twop^[11]. The server only returns the quality information data required by the client, no longer renders the client display page and controls the display effect of the client, and combines the business logic of the field application object to encapsulate the data interface required by the client. Usually, each view developed by the server is called an interface, or API, and the client obtains data information through the access interface. The server and the client adopt the Resultful interface style through the HTTP protocol, encapsulated as a unified interface of `app.get/post('/route address', function(req, res){}`. The client connects the transmitted data

information to the chart API interface Binding is used for visual rendering and mapping. This design separates the client and server for development without interfering with each other. When integrating, only need to complete the connection according to the interface of the two, which speeds up the efficiency of development and reduces development and Maintenance costs.

4.1.2 System modular design

The modular design enables each functional module to be separated separately, avoiding troubles caused by complex and interlaced logical relationships in development and maintenance. The overall module division of the remote visual quality management of the large-scale parts production line of the gantry machining center is shown in Figure 4. On the basis of separate development, each layer of the operating system is developed for functional modular design.

Display layer: The remote management operating system is based on the browser for visual display of production line quality management information and remote cross-platform information transmission, which is split into data analysis module, inspection task module, quality audit module, historical record module, etc. Each module is embedded in the display layer for visual analysis and display of production line quality information.

Data layer: The cloud data operating system is based on the powerful remote operation function of Navicat for MySQL software and the processing ability of SQL language. It operates the MYSQL database data deployed and served on the cloud platform, and builds the relationship model of the data information of the quality management system. The data information obtained by the client is stored in the background quality information database through the connection module.

Logical layer: The web server connects the remote operating system and the cloud data operating system to complete the transmission, release and feedback functions of quality data information. By creating the logical relationship of data information running in each module of the system, binding the logical objects between the client and the database, let the whole system run interactively.

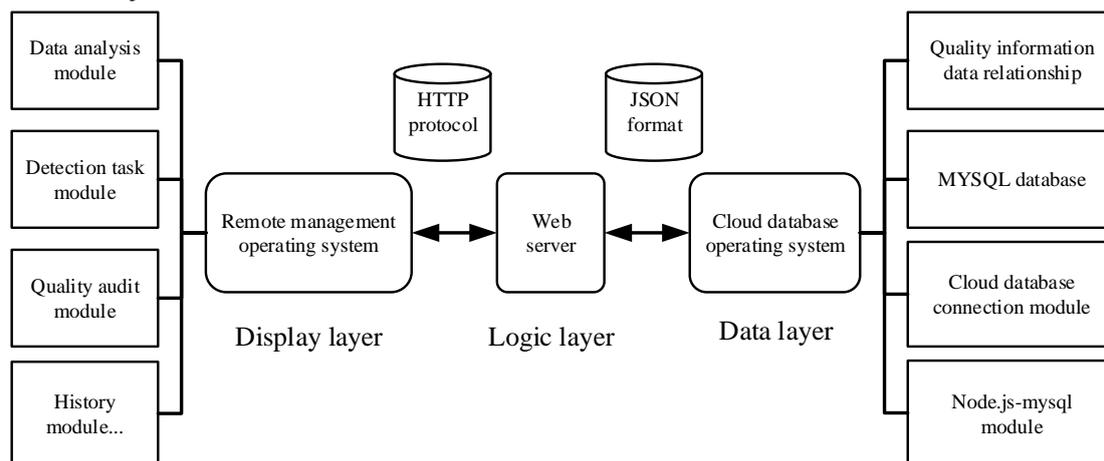


Figure 5. Modular design

4.2. System implementation

Using the WEB-based remote visual quality management method of the large-scale parts production line of the gantry machining center proposed in this paper, a set of remote visual quality management system is developed through data visualization technology and cloud remote transmission deployment technology. Choose to host Google, Firefox, IE and other kernel browsers as the client platform, and use the VS code development tool to develop the entire system. The Express framework is used to develop a web server as an intermediary

between client and database transmission, and the client is developed and deployed based on VUE scaffolding.

The user accesses the cloud address of the quality management system through the browser device, and the data information is transmitted to the browser through the wireless network, and the browser is parsed and displayed, and the product quality, inspection tasks, historical records, quality statistical analysis, etc. can be viewed through interface operations. The staff completes the quality inspection task through the operation interface, and completes the automatic upload of relevant data information.

5. Conclusion

This paper develops a web-based remote visual quality management system for the large-scale parts production line of a gantry machining center, studies a structural method of remote visual quality management based on web technology, uses data visualization technology and cloud remote deployment solutions, and solves the poor display effect of the management system. , Poor interactive experience, inability to cross-domain access and other issues. Compared with traditional quality management systems, this system is intuitive, has better human-computer interaction experience and remote remote access functions, and supports simultaneous operation of multiple terminals, providing a basis for distributed work deployment. The application of data visualization management is becoming more and more extensive, and the large amount of data generated in production needs to be presented in an intuitive manner. Product quality management is an indispensable part of the manufacturing industry and has guiding significance for the intelligent production of the manufacturing industry.

Acknowledgments

Supported by The Innovation Fund of Postgraduate(y2020001), Sichuan University of Science & Engineering.

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