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Design and Implementation of Discrete Manufacturing Mes System Based on Rfid Technology

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ABSTRACT. *Aiming at the characteristics of discrete manufacturing with multiple varieties, small batches, frequent process changes, and difficulty in implementing information, it adopts RFID technology, multiple communication methods, and layered design ideas, combined with multi-thread synchronization technology and database-aided design program. The discrete manufacturing MES system can complete the tracking of discrete manufacturing in-process products, product quality traceability, real-time data collection on the shop floor, reasonable arrangement of the workshop production plan, monitoring of enterprise equipment and personnel at any time, and real-time feedback correction of the process. A new method of on-site production data acquisition and processing was explored; at the same time, a configuration-based secondary development method was adopted during the implementation of the system to improve the efficiency of software development.*

KEYWORDS: *Mes, Rfid, Discrete manufacturing*

1. Introduction

Manufacturing execution system (MES) is an advanced management technology for the manufacturing workshop. It aims at the management of the executive layer between the enterprise planning layer and the industrial control layer. It studies how to plan the schedule and products in the manufacturing process. Comprehensive consideration of process control, material management, quality monitoring, equipment management and cost management, emphasizing the implementation of manufacturing plans and the control of product manufacturing process. Making the collection, transmission, processing and feedback of information on the production site accurate, timely, System and science to realize the optimal scheduling of production operations and the dynamic reorganization of manufacturing resources, and improve the transparency and agility of manufacturing management. Discrete manufacturing not only has the traditional manufacturing process, but also has a dynamic process of product design-process feedback. Therefore, the main aspects of the discrete manufacturing MES system Provide workshop management personnel, information technology personnel, enterprise management personnel, planners with

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plan management, resource management, report statistics management, workshop operation management functions, and require real-time collection of on-site production data and feedback back to the MES system. Data analysis, statistics, and finally achieve the goals of paperless operation, standardized operation, automated dispatch, real-time monitoring, and scientific management of discrete manufacturing workshops according to the corresponding rules. In order to achieve the above goals, the system uses radio frequency identification technology (Radio Frequency Identification, RFID), combined with wireless communication technology, and uses RFID technology-based data acquisition terminal (Intelligent Data Terminal, IDT) to achieve the upload of workshop production data and release.

RFID uses electromagnetic wave induction or propagation to carry out data communication between electronic tags and readers. Electronic tags are classified into active tags and passive tags. The use of RFID technology to solve the real-time data collection of discrete manufacturing workshops has the following advantages: (1) small size, non-contact, changeable shape, and reusable; (2) unique ID number, difficult to clone and imitate, and high security; (3) No fear of pollution, no need of light, flexible identification method; (4) Data can be rewritten and large storage capacity; (5) Multi-tag identification at the same time, long distance and fast speed.

2. Rfid Application Project System Overall Plan

According to the characteristics of the discrete manufacturing industry and the particularity of the manufacturing plant, the following design solutions are given in the realization of the management function: 1) Because the shape and size of the work-in-process in the manufacturing industry vary, and any surface of the material may be used for processing In addition, the processing site environment is relatively harsh, and the electronic label is not suitable for adhering to the surface of each workpiece, so the electronic label is adhered to the pallet. When the workpiece needs to be processed, the workpiece is removed from the pallet and placed on the pallet after completion. Ready to enter the next process; 2) In order to save production costs, each electronic tag needs to be recycled after the corresponding parts are processed, and the electronic tag is re-associated with the part number of other WIP; 3) the electronic tag of the WIP The code does not contain process information, but the process information and processing quantity information of this part can be found back through the electronic label; 4) Fix the REID reader on the device, and correspond the reader to the device in the database. The device information is included in the number of the reader. When the workpiece is processed by this device, the device information is recorded in the processing information of the workpiece; 5) The quality inspection of each process is treated as a special process. After the product is qualified you can enter the next process and record the test data. If there is a quality problem, the process information of the quality will be fed back (mainly feedback on which equipment this process is processed and by whom).

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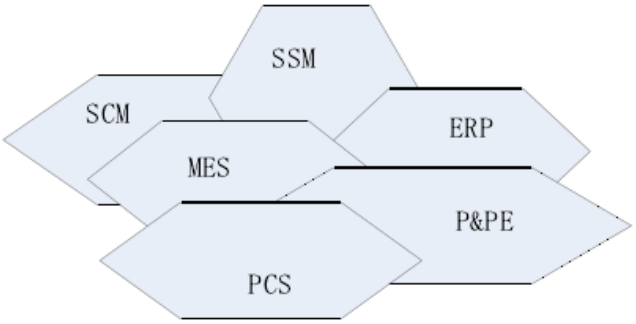

Fig.1 Mes External Environment Model

The density of the data collection point is determined according to the spatial position of the number of monitored processes in the production process. The process here refers to a basic process defined according to the demand for production process monitoring or a process group composed of multiple basic processes. According to the different characteristics of the assembly production process and the assembly production system layout, the characteristics of the process and the method of data collection will also be different, so that the location of these data collection points will generally be different. When considering the factors of equipment cost, data volume, data complexity and spatial location, it is impossible to set a data collection point for each state of each process of the assembly production process. Taking the process of a certain blade as an example, it can be seen that the complexity of a small moving blade has reached as many as 25 steps, and it is obviously unreasonable to establish monitoring points for these 25 steps. Therefore, it is necessary to merge the monitoring process and status, and to reduce the number of monitoring collection points by grouping the process and its status.

Generally, follow the following steps to merge processes or states: 1) Analyse the production process of the product and merge non-critical processes. In the production process, the accuracy of production and processing of certain processes is relatively low, and generally meets the production requirements. For these processes, the data monitoring is cancelled. 2) Combine adjacent processes that are processed on the same equipment. Some products can be processed in the same equipment before and after several procedures. These procedures should be combined, and use this equipment as a monitoring point to monitor the more critical data. 3) Merger according to the layout of factory equipment. The process is generally connected between the completion of the previous process and the arrival state of the post process, and between these two states is the material handling process between the processes. However, in some production processes, since the production equipment corresponding to the front and back processes are very close to each other, and this process is not a critical process, the process can be merged.

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3. Hardware and Interface Design

The interface program transfers the real-time data collected from the workshop to other systems. The interface uses timing and triggering to transfer information HJ. Using the design concept of middleware, the interface program is set on the MES server side, other programs call the interface program. The interface program mainly completes the following data transmission: user information, processing information, processing equipment information, meld information, process parameter information, process route, product information, inspection data, report data, etc. The MES system is aimed at the executive layer management problem between the enterprise planning layer and the industrial control layer. Therefore, the existing ERP system and PDM system of the enterprise need the MES system to provide reliable, timely and accurate information support. The management process of the workshop floor does not provide direct and detailed support issues. In order to prevent the “fault” of the workshop management information, this system uses a general data interface program to distribute the soft and hard data collected on all workshop terminals (American National Standards) the association and submits it to the upper management system to provide data support for enterprise decision-making. The interface program adopts the middleware development idea, integrates the data parameter transmission method of the MES and ERP system, uses the timing and event triggering methods to call the interface function, and uses the socket, queue, and thread technology to realize the upper management (ERP) and execution layer (MES))Data interaction.

In the discrete manufacturing industry, since the production process is not a pipeline operation, the processing procedures of different workpieces are different. It is obviously not feasible to formulate the working condition monitoring for each workpiece according to the production process. But no matter how large the variety of the workpieces and how complicated the processing procedures are, it must go through the corresponding equipment to achieve the final quality. Therefore, in the discrete manufacturing industry, if you want to monitor the production situation, the choice of the monitoring point should be to establish the corresponding monitoring point with the equipment, instead of using the process as the monitoring point like a pipeline operation. Therefore, the layout of workshop equipment affects the construction of RFID systems in discrete manufacturing. -The production process of a workpiece can be regarded as the change process of the position of the workpiece on the production line, in general, it mainly undergoes changes between the following three positions: raw material warehouse-transfer between processes-finished products Warehouse. In terms of the manifestation of the workpiece, that is, raw materials-half-cost products-finished products.

4. Design of Mes System Based on Rfid

In order to enhance the system's scalability, reconfigurability, adaptability, configurability and other good system performance, the layered idea is adopted in the structure, and the discrete manufacturing MES system is divided into 4 layers to

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design, while Adopt the design idea based on the plug-in universal auxiliary database, penetrate all the systems, and manage the data in a unified way, ensuring the coupling requirements between the layers and the layers.

The system is divided into MES workshop layer, MES management layer, interface layer and existing system layer, and the layers interact with each other through network or interface program to realize the upload and release of the entire enterprise data stream. The IDT developed by RFID technology is used to collect field data, communication program controls the sending and receiving of data, and the workshop workstation performs bus round robin on all terminals in the frequency band through the base station. If a certain terminal is operated, the operation data is received and done through the base station Processing, the communication program responds to terminal operations.

Table 1 Rfid Real-Time Data Collection Table

Line Name	Data Class	Note
ColID	AutoID	Automatic numbering for easy identification
ColTime	Time	Acquisition time for identification
ColWorkStaID	Number	The number is linked to the station information and contains specific operation information
ColPrdtID	Number	The number is linked to product information and contains specific product information
ColManID	Number	This number is linked to employee information
ColOperID	Number	The number specifies the person who needs to operate
…	…	…

IDT's design is based on the real-time data collection of the discrete manufacturing workshop. According to the performance requirements of the on-site operating environment of the workshop, the number of characters in all data content cannot exceed 800. If represents the received data, Length (fRevString) is its length, if it is greater than 2048 (converted to hexadecimal is 800), no longer judge. When the communication program receives the data, it first finds the position of the head and tail of the data string, respectively represented by variables i and j, then i=pos; j-pos. Furthermore, the CID and spider P addresses can be obtained to determine whether the data length is correct, and the data content can be extracted and verified. If the received CID and STEP are both 0, no processing is performed, otherwise, the corresponding CID and STEP are found, the data is analysed and processed, and then the corresponding operation interface, processing results, and request data are sent back to IDT. This completes a communication process.

5. Conclusion

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In the process of manufacturing informatization, discrete manufacturing is difficult to implement due to frequent changes in production processes, complex workshop environment, and difficulty in collecting field data. The discrete manufacturing MES system designed and developed by RFID technology and 433M wireless communication for the hardware platform, combined with the planning service program, communication program, management program and interface program developed by the object-oriented programming language, can meet the real-time data collection of the discrete manufacturing industry. With the requirements of monitoring, automatic scheduling of workshop operation plans, paperless operation on the production site, and timely operation of materials. After being popularized and applied by a number of representative large-scale discrete manufacturing enterprises, it has achieved good results, and has obvious effects in reducing work-in-progress, shortening production cycles, and reducing paper and data entry.

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