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Research on RFID Application Model of Ball Screw Production Line

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Abstract. Put forward the frame of RFID technology applied in ball screw production line. Aim at the blank distribution、product processing and the finished product testing in the process of ball screw manufacturing , Adopt radio frequency identification technology which is widely applied at present, the PC can be connected to internet by working with read and write only need ordinary routers, traditional wiring is reduced, information collection、delivery and sharing of workshop running state is implemented, efficient manufacturing collaboration from resource management to operations management to job execution personnel is supported, and the production efficiency and production quality is improved.

Introduction

Ball screw manufacturing is the process from drawings (CAD system) to physical. Designers mainly design the geometry parameters of the ball screw parts; workers process the various parts on the basis of these parameters. Traditional processing includes blank distribution, processing and manufacturing of products, finished product testing etc. Up to now products processing and manufacturing is with relative higher degree of automation in these a few links, which can use more mature method of NC. Blank distribution and finished product testing mainly depend on artificial, which are low efficiency, low degree of automation. And low degree of visualization, data redundancy, missing, and wrong of production line existed in the production workshop of ball screw, lead to the real time production conditions can't be mastered by enterprise management so that accurate coordinate and control will not realize in time. A new way to solve the above problem is offered with the appearance of RFID technology (Radio Frequency Identification). RFID technology is a non-contact automatic identification technology, which can identify target and get the relevant data and information automatically through radio frequency signal. The technology has many advantages such as: large capacity of information, strong ability of anti-interference, easy to read and write confidentiality, etc. At present, RFID has been widely used in logistics, retail, security, automotive industry and many other areas. the domestic and foreign scholars study RFID technology in the field of product manufacturing mainly concentrated in management for product supply chain, logistics and distribution of production line, process control of the assembly line, quality management, and establish the evaluation system for RFID technology applying [1-5].In general, these studies mainly on unilateral RFID functional technical solutions, study for the aspects of RFID data information integration and application mode is very little at the same time. This paper will be based on the characteristics and demand of ball screw manufacturing line, put forward the application model and implementation process of RFID using in ball screw manufacturing line.

Application Requirements Analysis for RFID

The application of RFID meets the demands of enterprise management. First, through RFID we can collect and monitor the real-time information of ball screw and parts manufacturing, so that management personnel at all levels of enterprise and workshop would master the workshop production status in time, and carry out a proper production scheduling and control at once; Second, through RFID we can track the dynamic information of raw materials, products in making, parts

and ball screw, and adjust production capacity according to the production and customer needs in time, achieve balanced production capacity, gradually realize the lean and flexible of workshop production management; third, through RFID we can identify and record the information such as the type and size of ball screw, control field control equipment such as the production line of screw, ball, seals, assemble line of ball screw, and programmable logic controller, vigorously promote the intelligent level of workshop production process; Finally, through RFID we can acquire and store quality information of products and parts at key points, and track product quality in time while quality problem appeared.

The application of RFID meets the demands of product in the production process. By RFID we can realize electronic records for cutting tool, work piece and auxiliary tools, in order to solve the problems of recording errors, low efficiency and management confusion which produced in the traditional manual management way; Through RFID we can realize automatic recognition and statistics of parts on production line, in order to avoid the problem of contaminated parts coding can't be identified caused by the bad production environment; Through RFID we can track and manage parts, optimize logistics process and parts inventory, improve the efficiency of logistics distribution, reduce the waste of WIP inventory; Through RFID we can read real-time information of production process, realize automatic control of process, guide the workers and machinery produce quickly and accurately to reduce the possibility of human error in the process of production, improve the level of production and manufacturing; Through RFID we can acquire and correlate the information of ball screw and parts, improve the related data of ball screw quality, realize tracing the information of ball screw and parts quickly and accurately.

RFID Applied in the Ball Screw Production Line

The RFID model based on ball screw manufacturing line. This article proposed an application model of ball screw manufacturing production line based on RFID according to the characteristics of ball screw manufacturing production line. Data and status information of WIP real-time acquisition on ball screw manufacturing production line mainly adopts RFID tags. Figure 1 is the system framework of RFID application model based on ball screw manufacturing line, the framework is established on the basic of RFID application mode of manufacturing, consists of processing and testing station, key components, database service system and digital information management system, through pasting the RFID labels on the processing and testing station, gather data information of WIP automatically, and establish the data correlation, convenient to realize real-time information interaction and integration among different workshop personnel, equipment and management software system in the company. Key parts refers to the important parts of the ball screw, on it RFID labels are pasted, through the data which collected from the RFID tags we can track machining precision and dimension of the parts timely, so as to adjust processing scheme timely when needed. Database service system can transmitted the information from the router to the digital information management system in time after a certain processing, and the digital information management system process the received information at once. on one hand, the digital information management system disassemble the production management information from the business layer of application system, and transfer instructions to PLC in the workshop for on-site control; On the other hand, the digital information management system can monitor the real-time running state of equipment and instrument at the bottom of workshop, and feedback the state data of equipment and instrument to management timely after analysis for decision making.

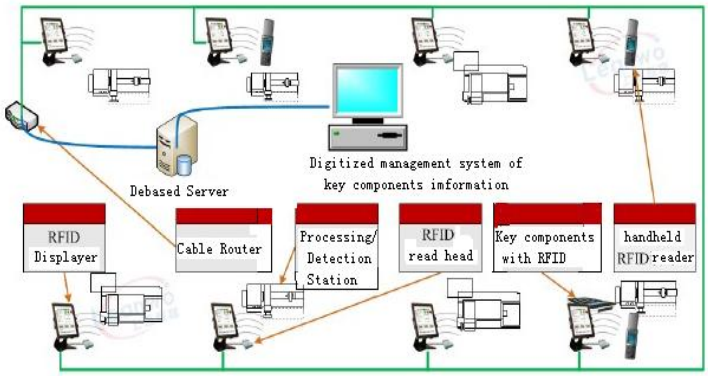

Fig.1 Based on the ball screw of the RFID application model framework

Material automatic recognition system based on RFID. The material automatic identification system based on RFID using barcode、touch screen to track the real-time material status of the enterprise. By barcode we can manage the accurate information and collect the related data of materials while they out-put or in-put warehouse. The materials managed by Barcode including: the components of ball screw, raw materials of the components, the equipment products. Put the barcode in the location where should not be collision and easy to be scanned during using and processing, and entering the corresponding bar code of raw materials while they out-put or in-put warehouse, realize fast and accurate entry of materials. We can also track online status of materials by scanning the barcode while the materials are in processing, monitoring running process of the materials, to ensure fast and efficient running in the workshop production [6-7].

The factory digital manufacturing system based on RFID. Factory digital manufacturing system which include the MES system and digital displayer system have many advantages: (1) with the function of traditional displayer management Equipment. for example: calendar of equipment plans, personal production plan, personal goal appraisal management, the figure of area task undertake, the displayer of safety without disaster, etc. (2) configuration an industry PAD with the function of RFID for each station. The PAD has the function of reading the electronic labels. Because the products have been using RFID for identification, so the PAD can read information on products by supporting software, such as: product information, processing technic information, order information, manufactured procedure information, etc. (3) provides RFID data interaction more flexible. Add the corresponding human-computer interaction interface on the basic of the original fixed RFID information interaction, innovative combination of RFID and electronic displayer, which can make the operator more initiative. For example, in the process of machining, operators can use RFID displayer system record/query the corresponding operation information、test data, and so on. (4) Configuration a large LED displayer in the workshop (using the existing LED displayer in the workshop), announce the useful information of workshop onto the board. Such as the production scheduling plan, daily production reports, order condition, etc.

The factory digital quality system based on RFID. Factory digital quality system include online detection system、quality process management. The precision of traditional test method is limited by measuring instruments and detection technology of workers, this set of systems place the RFID tags into specific physical of the production line, make use of RFID to collect data point. Handheld RFID read-write device (Reader) send microwave signal of query, after built-in micro strip antenna of RFID reading head which installed in processing/testing station receive the microwave signal of query, part of the microwave energy is transformed into electric energy for its own electricity circuit, at the same time, the other part of the microwave reflect back the information about themselves after being modulated. Read/write device receives the microwave signals of reflection data information with a ball screw groove profile, and get the stored identification code information after which is demodulated, this information is received by the data server, transferred to the digitized management system of key components information, the contour curve is reconstructed and

analyzed inside the computer to extract the geometric characteristics, getting the errors of all the geometric parameters of the screw, and compared with the design standards of ball screw, so that we can judge the eligibility of the screw. according to the result of judgment, we can make plans, give instructions、control processing、data collection and real-time dispatch in the manufacturing site. meet real-time visual control of the scene for customer, reduce errors, improve efficiency, continuously improve the requirements of the manufacturing process, realize lean manufacturing. The system has the function to identify moving object identity code automatically with no contact [8-12].

Factory digital central monitoring system based on RFID. Through factory digital central control system, we can record the key element of production process comprehensively and track the quality of product completely, figure out product percent of pass and the fraction defective accurately, to provide quantitative indicators for quality improvement; Based on the products quality analysis results in different stages of the production process to maintain the factory products prophylactic ally [13-14]。

(1) Quality inspection standardization management

Through MES we can establish perfect test model. The model can indicate the method of material inspection, including what project should be inspected for the material, and the detailed requirements of the project, the method of test, different quality levels corresponding to the scope of the inspection value. The model can be integrated with PDM, obtained inspection items、inspection requirements and so on from the process design document, and manage the various quality documents which formed in the process of quality management.

(2) Quality inspection activities management

Quality inspection activities are brought into the production scheduling and dispatching as a task. After the quality department personnel log in MES system, they can view the quality inspection task of themselves, and prepare for carrying out the quality inspection task; In the process of Manufacturing task carrying out, the MES system prompt the appropriate quality execution procedure, such as sample processing、self-inspection process, etc.; After the manufacturing task is complete, quality task can start.

(3) Statistical analysis of the quality

Quality promotion relies on executing the production process strictly, and also relies on quality verification of quality personnel through testing. Through the analysis of quality data to find abnormal of quality and trends of percent of pass and the reasons of quality ultra-tolerance. Therefore businesses need to record and analyze all the quality data of the production process timely and accurately, by means of quality analysis to find out the cause of bad quality and the abnormal situation, achieve continuous improvement of quality.

Conclusions

Aim at the situation of network cabling complex in the ball screw production environment and traditional manual production management is difficult to achieve precise management, construct the application scheme of products data wireless acquisition based on RFID, which has the following features:

(1) Hardware is simple, the PC can be connected to the internet by working with read and write only need ordinary routers, reduce the traditional wiring.

(2) using the technology of RFID, realize information collection、transmission and sharing of the workshop running state, support efficient manufacturing collaboration among resource management、operation management and operation executive personnel, improve the production efficiency and production quality.

(3) The data model based on RFID oriented to ball screw production management has guiding significance for implementing RFID technology in manufacturing enterprises.

(4) Combining with analysis of production management business function, production

management system formed by designing, developing and assembling of the functional components, has good reconfigurable property, can meet the personalized needs of different enterprises workshop production management.

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