

Research on RFID Technology Applications in Printing and Dyeing Industry

Jinlong Lv^a, Zhi Li^b, Benfei Shi^c

School of Electrical Engineering, Qingdao University, Shandong Qingdao 266071, China

^aqddxljl@126.com, ^b675184958@qq.com, ^c2567902598@qq.com

Abstract

The development trend, existing problems of modern printing and dyeing enterprises were analyzed. It pointed out the applications of RFID technology from the data collection and production management. And it illustrated the working principle of RFID technology. The system which can achieve real-time data of the printing process acquisition was designed with the example of MES system based on RFID technology in printing and dyeing company. The practical application of RFID technology in printing and dyeing were elaborated. It had an important significance to achieve the information transformation of the printing and dyeing process with the use of RFID technology .

Keywords

RFID Technology; Textile Printing and Dyeing; The Information Transformation.

1. Introduction

China is one of the world's largest producer of textile printing and dyeing besides its annual production processing capacity is in the front ranks of the world. But domestic printing and dyeing enterprises widely have the problems of management process multifarious, low information level, heavy energy consumption and low production efficiency. In recent years, our country implements the sustainable scientific development view and puts forward new requirements of energy conservation and emissions reduction to the printing and dyeing enterprises; on the other hand, rising raw material costs, labor costs, competition between enterprises at home and abroad, and the informationization tide represented by the Internet bring huge opportunities and challenges to the traditional printing and dyeing industry. At present, most of the dyeing and printing enterprises in China have realized that the information technology played an important role in the optimization of enterprise production management process, the enhancement of enterprise competitiveness and improvement of production efficiency. ERP system combined information technology and advanced management ideas constructs the enterprise information platform by using the ideas of systematic management which is on the basis of information technology. The successful and efficient operation of ERP system depends on the real time and accuracy of data input [1]. Nowadays some enterprises lag in production data collection and monitoring technology which are mainly depend on manual record paper media to gather and transmit workshop production information. There are problems like error-prone, low efficiency of production, data acquisition not timely, the lack of implementation of production plan and production schedule of real-time visual monitoring problems and so on, failed to realize information management of the whole process from order to product. In order to solve these problems, the RFID technology comes into the line of sight of modern printing and dyeing enterprise and its practitioners. With the use of RFID technology reforming the dyeing and finishing process and collecting the real-time production data, it can be helpful to realize visualization for condition monitoring and optimization of planning and scheduling which can provide real and effective first-hand data of production [2]. In particular, the integration of the RFID system, MES system and

effective management of ERP system will greatly improve the production efficiency of enterprises, yield and informatization degree and enhance the core competitive ability of the enterprise.

This article takes the MES system based on RFID of a company as a example, designs the real-time data of printing and dyeing process acquisition system based on RFID technology [3], expounds the important meaning in the practical application of RFID technology in printing and dyeing industry.

2. The scheme design of RFID applied in printing and dyeing process

RFID technology, also known as radio frequency identification technology, is a kind of use of the space coupling achieving non-contact automatic identification, tracking target objects and reading relevant data label technology [4]. Compared with the traditional bar code technology, it has the advantages of non-contact gathering data, fast speed, large data storage capacity, high accuracy, simple and easy to use, recycled, resistance to environmental pollution [5]. The RFID system is mainly composed of electronic tags, card reader, controller, middleware and computer database system [6].

2.1 The operating principle of RFID

RFID is the system which uses RFID technology to collect production information in real time, such as production processes, production equipment, production quantity, production time, production personnel, production teams and so on. In order to prepare for the upper MES and ERP systems displaying, saving and generate table etc. the information which is extracted, analied and filtered by middleware is transmitted to the computer database system, RFID tag which is written the information of the production is on the move along with the fabric, when it reaches the identified range of reader, the reader will read the card information, and collected data will be transmitted to RFID middleware through the connection of controller on the computer by the way of WiFi wireless communication , the information will be classified by RFID middleware and then be stored in the computer database, management client software access database through the server, to check the real-time production situation of workshop, to analyze production data, and to adjust the enterprises production plan [7]. The operating principle diagram of RFID system is shown in figure 1.

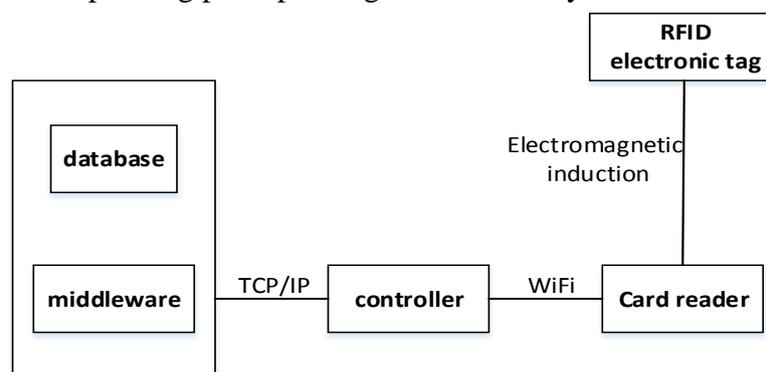


Figure 1. The operating principle diagram of RFID system

2.2 Scheme design of RFID technology applied in dyeing and finishing process

2.2.1 Hardware preparation

Electronic Tags: RFID electronic tags, also known as radio frequency card or transponder ,have two main types.One is a passive tag. The tag enters the recognized range of the reader and then the magnetic induction line generated by the cutting reader generates an induced current and the induced electromotive force.So the stored data information transmits to the card reader.The other is an active tag.The tag sends information to outside by sending a radio frequency signal automatically [8]. Electronic tags carrying the material information of production can be read or wrote data. Combined with the actual situation of the printing and dyeing enterprises, tags which are none–power-supplied,

maintenance- free, low cost are most in line with the needs of enterprises. According to its different uses, it can be classified into staff card, material card, working procedure card.

Card Reader: The typical RFID reader is mainly composed of RFID RF module, control module and reader antenna. When card reader launch a specific RF signal, the signal tag induct it and will give the corresponding response signal. Card reader receives the signal and transmits data to the controller through wireless communication technology. Card reader has the function of receiving and sending signal, displaying information and data inputting and so on. The card reader used by enterprise has a simple function, including a four line of liquid crystal display area and a button function area, data input, confirmation and cancellation, etc. All operations in card reader including swiping card, keying etc., is considered to be an event. Each event produces a data, and real-time transmit to the server. Event data can be processed by the server program which generates corresponding production information records and displays specific content on the screen. So human-computer interaction can be realized [9].

Wireless Controller: A controller can simultaneously receive the information of a plurality of card readers, and the reader can avoid the trouble of the installation and wiring of the workshop through the wireless communication transmission data between the card readers. The information collected by wireless controller is transmitted to the RFID middleware, and then middleware completes data extraction, analysis and filtration [10]. Processed data is transferred to the background database.

Computer Server: It is used to install RFID middleware software and database. RFID middleware is independent of RFID application system and enterprise application systems which can remove useless information, screen the useful information, reduce the burden of the database and the complexity of system and facilitate background applications realized and maintained [11].

The RFID wireless card reader is installed at each station, and the card reader is connected with the controller through the WiFi. The controller is usually installed in the roof or workshop column etc. where is taller and convenient to install and maintain controller is connected with the middleware server through the network. Middleware server and database server can use the same server, however, if the number of card reader is more, the middleware server should use a single server in order to ensure the response speed.

2.2.2 Operation Flow Design

a. **Worker Post.** Each operator is provided a RFID employee card. When they brush staff card they land on the reader. Card reader shows the employee's name, position and the default process on the first line. Personal workload will be recorded in the operator.

b. **Cloth Delivery.** Under the dyeing and finishing process with the production of a RFID card, that is, the material card. In the printing process, the RFID card of the production is put on the card sender and then the information is wrote. At the same time, a small bar code is printed, including the pot number, work piece number etc., and then put the small bar code on the RFID card. RFID card flow with the fabric.

c. **RFID Card Transfer.** When the fabric flow to the production station, operation workers removed the material card, and then the card is swiped showing Summons relevant content in the card reader. If there is no need to modify anything, "confirm" key is pressed. The process and work station, production workers, pot number, and the whole pot weight production information will be stored automatically by the system, and card reader will show that the information is stored successfully. The system records the current time as processing start time. When the process is over, operatives scan again electronic tags and the system records the end of processing time calculating the hours and updating the fabric information for processing.

d. **Process Change and Handing-off Process.** The station belongs to the process does not change frequently, and the default process is commonly used. If there are changes to RFID card, we can input the optional process ID of the card reader, which has been set up in the database in advance. If press the enter, the card process information displayed on the card reader will be changed.

3. The significance of enterprises of the information transformation by using RFID technology to realize the printing and dyeing process

It is of important practical significance for the development of modern printing and dyeing enterprises by using RFID technology with the information transformation to realize the printing and dyeing process. The significance mainly is reflected in implementing the function of RFID system:

a) Improve the rationality of pricing procedure.

RFID system can real-time automatically collect the processing procedures, the start time and completion time, and independently analyze the rationality of process time [12]. According to the actual situation of the production, the enterprise managers understand the processing time of each process, and ensure the rationality of the process pricing.

b) Enhance the visibility and transparency of printing and dyeing process to realize real-time production monitoring.

RFID system can also real-time automatically collect the information of the processing procedures, the use of equipment and the operation of workers[13]. Workshop managers can monitor the production schedule of each order through the system, the completion of the order and the timely adjustment of production planning at any time. The defective rate can be effectively controlled, production cost can be saved, production efficiency can be improved through making clear the responsible person.

c) Establish a fair performance evaluation mechanism so the efficiency of employees can be improved.

The information collected by RFID system is real-time and accurate, which avoids the artificial negligence and intervention. It can help managers to establish a fair evaluation mechanism. In order to stimulate the work of the staff's enthusiasm, automatic statistical workers' workload and accurate calculation of workers' wages can make employees feel the fair and just atmosphere of enterprises. At the same time management can keep abreast of differences between staff and enterprise standard. Setting up different evaluation mechanism for employee, team and workshop and improving the production enthusiasm of workers play a role in encouraging the continuous improvement of production efficiency.

d) Improve enterprise scheduling scheme to solve production bottleneck

RFID system has realized the production process of information collection, transmission and the real-time and reliability of process. At any time, it can provide the information of different stations in online orders, online time [14] etc., and help enterprise managers find production bottlenecks that impact on the progress. It is helpful to the effectively production balance.

4. Conclusion

The development of electronic commerce and information economy make printing and dyeing industry into a network, customization, short cycle, zero inventory of quick production period. The business which can occupy the time effective of information collection, exchange and the decision, will grasp the initiative in the competition! The traditional printing and dyeing industry is rebuild by using RFID technology. So the business can realize production information real-time visual surveillance and accelerate the reaction speed of enterprise to cope with changes in the market. What's more, it can adapt to the development of the information age requirements [15]. The MES system based on RFID technology is executed by the printing and dyeing enterprise. It has realized that the workshop real-time monitor and controled, workers productivity embodied in real time, information of product quality responded rapidly. What's more, it has realized real-time monitoring workshop, real-time performance withdrawals worker productivity, rapid reaction product quality information, effective analyzed utilization rate, reasonable calculated of process pricing and salary statements automatically generated. Effectively enhance the information level and the production efficiency of the enterprise. It should be noted that printing and dyeing enterprise information

construction is not only the RFID real-time data acquisition system established in enterprise internal, but also includes enterprise resource planning (ERP) system, manufacturing execution (MES) system, warehousing and logistics system, e-commerce and other comprehensive application and evolved integration, which determines the printing and dyeing enterprise informatization construction is a process of complex, continuously developed and gradually completed. So enterprises must combine their own actual situation, make full use of existing resources and transforme the results of the information construction into the production efficiency.

References

- [1] S. Baysan, A. Ustundag, The Cost–Benefit Models for RFID Investments, in: A. Ustundag (Ed.), Springer, London, 2013, pp. 13–22.
- [2] F. Berthiaume, K. Donahue, J. Rommel, RFID Tag Selection Report Rutgers Center for Innovative Ventures of Emerging Technologies RFID Tag Source, 2011.
- [3] A.J. Mercer, R.K. James, G. Bennett, P. Patel, C. Johnston, J. Cai, RFID testing and evaluation for an RF-harsh environment, in: IEEE International Conference on RFID-Technologies and Applications (RFID-TA), 2011, pp. 95–102.
- [4] R. Agrawal, A. Cheung, K. Kailing, and S. Schonauer, “Towards Traceability across Sovereign, Distributed RFID Databases,” Proc. 10th Intl Database Eng. and Applications Symp. (IDEAS), 2006.
- [5] Fusheng Wang, P Liu, “Temporal Management of RFID Data”,proc.31st VLDB conf, 2005.
- [6] D. Liang, S. Yuan, “Structural health monitoring system based on multi-agent coordination and fusion for large structure,” Adv Eng Softw, 86 (2015), pp. 1–12
- [7] A.V. Barenji, R.V. Barenji, M. Hashemipour, ”Structural modeling of a RFID-enabled reconfigurable architecture for a flexible manufacturing system,” Proceedings of 2013 European conference on smart objects, systems and technologies,VDE (2013), pp. 1–10
- [8] T. Li, S. Chen, Y. Ling, ”Identifying the missing tags in a large RFID system,” Proc. of the 11th ACM International Symposium on Mobile Ad hoc Networking and Computing (Mobihoc), ACM (2010), pp. 1–10
- [9] X. Liu, S. Zhang, B. Xiao, K. Bu, A. Chan, ”STEP: a time-efficient tag searching protocol in large RFID systems,” IEEE Trans. Comput. (99) (2015), pp. 1–14
- [10] V. Namboodiri, L. Gao, ”Energy-aware tag anticollision protocols for RFID systems,”IEEE Trans. Mobile Comput. (2009), pp. 44–59
- [11] Robin.G.Qiu. RFID-enabled automation in support of factory integration [J]. Robot Computer-Integrated Manufacturing, 2007(14): 677-683.
- [12] Q. Xiao, K. Bu, B. Xiao, Efficient monitoring of dynamic tag populations in RFID systems, in: Proc. of the IFIP 9th International Conference on Embedded and Ubiquitous Computing (EUC), 2011, pp. 106–113.
- [13] S. Zhang, X. He, H. Song, D. Zhang, Time efficient tag searching in multiple reader RFID systems, in: Proc. of iThings, 2013, pp. 481–488.
- [14] Z. Zhou, H. Gupta, S. Das, X. Zhu, Slotted scheduled tag access in multi-reader RFID systems, in: Proc. of the 15th IEEE International Conference on Network Protocols (ICNP), 2007, pp. 61–70.