Application of Industrial Robots in Automated Production Lines under the Background of Intelligent Manufacturing

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Abstract. Intelligent manufacturing is the theme and main direction of the "Made in China 2025" development strategy, and the application of industrial robots is an important direction of intelligent manufacturing. In the next few years, industrial robots will be widely used in various enterprises, which will inevitably require a large number of high-tech industries. Industrial robots are high-tech products of modern society and play an important role in the process of economic development, especially in the manufacturing industry. Industrial robot technology is widely used in automated production lines, so that industrial production efficiency can be greatly improved. Instead of manual labor to carry out various complex production and operations, to achieve industrial production automation. Analyze the application of industrial robots in automated production lines at this stage, and explore their future development directions, so that they can better serve the manufacturing industry. This article takes the industrial robots and PLCs in the industrial automation production line as the research object, and takes the automated production line for mass production of a product as an example. It explains the joint control scheme of the PLC controller and the industrial robot controller, and provides for the construction of joint control of similar production lines in the future.

Keywords: Intelligent Manufacturing, Industrial Robots, Automated Production Lines, Plc

1. Introduction

Intelligent manufacturing is based on new digital information technology, which integrates newly developed information technologies, such as the Internet of Things, big data, cloud computing, and design, manufacturing, management, service and other manufacturing operations. It is the general term for advanced manufacturing processes. It has the functions of self-awareness, intelligent optimization, self-determination and precise self-realization of information depth [1]. Nowadays, intelligent manufacturing has become an important development point of China's manufacturing industry. This is an opportunity for our country to carry out a new round of industrial revolution. At the same time, industrial robots are expected to deeply integrate with the Industrial Internet and the Internet of Things in the information age. In the context of the era of intelligent manufacturing, machinery manufacturing
enterprises need to adjust the training goals of intelligent manufacturing in time to solve the problem of the shortage of high-level talents in intelligent manufacturing [2]. The growing demand for intelligent manufacturing talents in enterprises, the use of industrial robots in industrial production will allow the creation of automated production lines. Compared with traditional manual production lines, automated production lines have obvious advantages in terms of production efficiency and product quality. Therefore, industrial robot technology has attracted wide attention from researchers. In this case, research on this topic is very important [3].

Manufacturing is one of the pillar industries of the national economy. With the continuous development of science and technology, industrial robots have gradually entered the public's field of vision, providing a new development direction for automated production lines [4]. Through the application of industrial robots in automated production lines, the production efficiency of the industrial industry can be greatly improved, the rejection rate can be reduced, and the production cost can be reduced while ensuring the quality of product processing, laying a solid foundation for the long-term development of the industrial industry [5]. Due to the increasing level of economic development and the increasingly complex market environment with fierce competition, the development of the manufacturing industry will also face unprecedented opportunities and challenges [6]. In this context, the introduction of industrial robots can significantly improve the level of manufacturing automation, accelerate the development of industrial intelligence, help companies enter the highly competitive market, and contribute to the overall transformation of the industry. The manufacturing industry and its increased economic benefits have improved [7].

The initial design goal of industrial robots is to release productivity, optimize production lines, help machinery manufacturing companies complete automated production and ultimately realize modernized operations and control manufacturing in the industry [8]. Industrial robots are equipment that combines multiple interconnected machines. In recent years, with the continuous development of science and technology, Internet technology has been widely used in various fields. Industrial robots combine Internet technology with mechanical production. Various manufacturing operations have been established during the production process, forming an automated production line based on industrial robots [9]. Although industrial robots have independent controllers and control systems, they are only one execution point in the automatic production line. The overall coordination of the production line and the coordination with some robot points are mostly based on the PLC system [10]. Therefore, in the automatic production line system based on PLC, after adding the industrial robot system, how to make the PLC and the robot system cooperate effectively is a problem that the current production line system needs to solve.

2. Method
The PLC fuzzy algorithm describes the fuzzy tracking problem, such as calculating the confidence map to estimate the probability of the target, where x is the target and o is the tracker. Assuming that in the current image, the center position of the target is the automatic blur function. Since the PLC works in the way of patrol scanning, its programming method is different from the general microcontroller and has certain particularities, especially in the implementation of complex. This is especially true in terms of control algorithms. On the basis of in-depth research and experiments, the key technologies of PLC fuzzy algorithm to realize PID control are summarized. Its definition is as follows:

$$E = 2\alpha \frac{e - a + b}{b - a}$$  \hspace{1cm} (1)

In the formula, I (z) represents the gray value at point z and the automatically generated fuzzy area around the target center. Assume that the two inputs of the two-dimensional fuzzy controller are the rate of change of the deviation x and the deviation m(x), and the output is the reference value of the controlled parameter in the controlled parameter:
If reliability, mean time between failures, and mean time to repair are represented by $R$, $MTBF$, and $MTTR$, respectively, then the reliability formula is:

$$R = \frac{MTBF}{(MTBF + MTTR)}$$

If reliability, mean time between failures, and mean time to repair are represented by $R$, $MTBF$, and $MTTR$, respectively, then the reliability formula is:

$$x' = \{x(z) = (I(z), z) | z \in \Omega(x')\}$$

3. Methods and Experimental Research Design

3.1. Robot Integrated Communication Scheme

With the gradual transformation from "Made in China" to "Intelligent Manufacturing in China", industrial robots now occupy a pivotal position in industrial production lines. Industrial robots are not only independent operations in production activities, but more and more. Robots or other industrial equipment work together to complete production tasks. Therefore, the system communication of industrial robots is very important. The various operations of the robot are carried out through pre-written programs, but in actual operation, if necessary, online programming can also be used to modify the relevant instructions, or manual manual interference to change the operation of the robot. Compared with traditional manual production, the manufacturing production of industrial robots has the characteristics of intelligence and automation. The production efficiency is higher, the operation accuracy is good, and the durability of industrial robots is better, and it can achieve long-term, uninterrupted work.

3.2. Practical Training Mode in the Context of Smart Manufacturing Needs

In the context of intelligent manufacturing, the practical training of industrial robot technology application courses includes general robot training such as skilled operation of robots, programming and debugging, and industrial robot construction and application on intelligent production lines. Various related technologies and industrial robot technology comprehensive training. Therefore, in the daily training, the related technology and the robot connection part should be trained to consolidate the foundation of the comprehensive application of industrial robots, and strengthen the comprehensive training on this basis. At the same time, the methods of practical training and evaluation also need to be changed accordingly. Based on this, the practical training mode of industrial robot technology application courses is summarized, which is divided into modules and levels, practical training methods are diversified, and evaluation is diversified.

3.3. Experimental Investigation Objects

First of all, the investigation and research method is used to conduct detailed and in-depth investigation and research on the choice of each type of automated production line enterprise, research data, research rules, and refine and summarize the first-hand information. This paper selects large-scale and small-scale automated production line companies, and conducts a practical investigation and research on the application of PLC technology.

As shown in Table 1, in the investigation of the research report of the experiment, a total of 100 automated production line companies were rationally selected and given an experimental research questionnaire, and a questionnaire survey was conducted on the automated production line company to evaluate each A factor of whether PLC technology is used in an automated production line. For this, we first need to study the integration of various modes of automated production lines in detail and thoroughly, and at the same time study the direct assimilation of data information in order to apply research and research methods, as well as to concretize and summarize specific cases. Secondly, it
analyzes the use of case analysis method, which requires a variety of automated production line model statistics, in order to analyze the status quo of industrial robot automated production line through case studies.

| Questionnaire issuance and recovery | Large-scale automated production line enterprise | Small automated production line enterprise | total |
|-----------------------------------|-----------------------------------------------|--------------------------------------------|-------|
| Issue                             | 35                                            | 65                                         | 100   |
| Recycle                           | 34                                            | 63                                         | 97    |
| effective                         | 33                                            | 61                                         | 94    |
| Efficient                         | 94.2%                                         | 93.8%                                      | 94%   |

4. Results

4.1. Industrial Robot Technology Based on Automatic Production Line

![Figure 1. The current model status of the production line](image)

As shown in the statistics in Figure 1, it can be seen that the current automatic production line has not been fully popularized, the industrial production tasks are more complicated and onerous, and there are hidden safety risks. Therefore, the role of industrial production lines based on manual operations in industrial production has been constantly weakening, gradually replaced by automated production lines, the main reason is that industrial production puts forward strict requirements on people's physical fitness and technical level, and people need to rest after working for a period of time, so production efficiency is relatively limited, and Automatic production lines will not be bothered by these problems. In the actual production and processing process, due to the different types of products produced, the shapes and functions of industrial robots used are also different, which also puts forward higher standards for industrial robots. It is not only required to have high production efficiency, but also to have the advantage of occupying a small space. Only in this way can it meet the needs of industrial production at this stage. Therefore, automated production lines are gradually being used by industrial production companies. When establishing an automated production line PLC and an industrial robot control system for joint operation, the PLC program must be strictly programmed and verified. PLC is the core of a production station and production link in the production line. It is necessary to coordinate the operation of the production line transmission belt, pneumatic equipment
and other actuators, but also to coordinate the reception of various sensor signals on the production line. It is also necessary to reasonably control the industrial robot, so PLC is still an important part of the automated production line. When establishing an automated production line PLC and an industrial robot control system for joint operation, the PLC program must be strictly programmed and verified. PLC is the core of a production station and production link in the production line. It is necessary to coordinate the operation of the production line transmission belt, pneumatic equipment and other actuators, but also to coordinate the reception of various sensor signals on the production line. It is also necessary to reasonably control the industrial robot, so PLC is still an important part of the automated production line.

4.2. Two Information about PLC and Industrial Robot

![Figure 2. Industrial robots with PLC as the core from 2012 to 2016](image)

As shown in the statistics in Figure 2, it can be seen that the current automatic production line has not been fully popularized, industrial production tasks are more complicated and onerous, and there are hidden safety risks. Therefore, the role of industrial production lines based on manual operations in industrial production has been constantly weakening, gradually replaced by automated production lines, the main reason is that industrial production puts forward strict requirements on people's physical fitness and technical level, and people need to rest after working for a period of time, so production efficiency is relatively limited, and Automatic production lines will not be bothered by these problems. In the actual production and processing process, due to the different types of products produced, the shapes and functions of industrial robots used are also different, which also puts forward higher standards for industrial robots. It is not only required to have high production efficiency, but also to have the advantage of occupying a small space. Only in this way can it meet the needs of industrial production at this stage. Therefore, automated production lines are gradually being used by industrial production companies. When establishing an automated production line PLC and an industrial robot control system for joint operation, the PLC program must be strictly programmed and verified. PLC is the core of a production station and production link in the production line. It is necessary to coordinate the operation of the production line transmission belt, pneumatic equipment and other actuators, but also to coordinate the reception of various sensor signals on the production line. It is also necessary to reasonably control the industrial robot, so PLC is still an important part of the automated production line. When establishing an automated production line PLC and an industrial robot control system for joint operation, the PLC program must be strictly programmed and verified. PLC is the core of a production station and production link in the production line. It is necessary to coordinate the operation of the production line transmission belt, pneumatic equipment and other actuators, but also to coordinate the reception of various sensor signals on the production line. It is also necessary to reasonably control the industrial robot, so PLC is still an important part of the automated production line.
5. Conclusion
There is no doubt that intelligent manufacturing will bring unprecedented changes and improvements to traditional manufacturing. In the context of intelligent manufacturing, industrial robots are increasingly used in industrial automation production lines, and are used in welding, spraying, handling, palletizing, gluing and other functions. They are also used in chemical, automobile production, casting, medical, Food production and other fields involving automated production are widely used. In the future, the application of industrial robots in automated production lines has become the general trend. Under this development background, the introduction of industrial robots can greatly improve the automated production level of the manufacturing industry and accelerate the development of industry intelligence. A reasonable structure of a robot and PLC joint control system It has also become the focus of technological innovation. Compile scientific and reasonable workflows for industrial robots and set precise production paths, thereby improving the efficiency of industrial robots and ensuring that industrial robots can operate safely and reliably in the process of stamping automation. The joint development of mature PLC control technology and industrial robot application technology is one of the key factors to measure the production efficiency and production scale of automated production lines. Therefore, this part of the content must be the focus of future research.

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