The application of industrial robotics in the textile industry

Liu Chang

Ningxia Polytechnic, Yinchuan, Ningxia, 750021, China

Abstract: The textile industry is an important livelihood industry in China, in order to reduce the human labour costs in the textile process, improve the quality of textile production and production efficiency, intelligent industrial robots are gradually being used in the textile production process. In this regard, in order to promote the intelligent construction process of the textile industry, reduce textile production costs, and promote the textile industry market economy is flourishing, this paper is based on the status quo of the development of digital technology, the integrated textile production process and related needs, industrial robotics in the textile industry in the application of the path to explore, in order to hope to learn from.

1. Introduction

the scale of China's textile industry, industrial chain integrity and production level, have been at the forefront of the international community, especially in the rapid development of digital technology under the premise of the textile industry into a new round of industrial change, intelligent production has become an inevitable trend in the development of the textile industry. In order to promote the intelligent construction of the textile industry, it is necessary to strengthen the application of industrial robotics in the textile industry to explore the path.

2. Overview of industrial robots

Robot since its inception has been more than 50 years of history, especially in the digital intelligence technology, robot has more functions and stronger recognition and response capabilities, with good production performance and production efficiency, robots have been widely used in all major industry sectors. Typically, robots are divided into industrial robots and special robots, of which, industrial robots are mostly used in the manufacturing sector, and often have multi-joint manipulator, in order to enhance the production efficiency of the robot. Specialised robots are used in non-manufacturing industries, such as the service industry, the military industry, the medical industry and agricultural cultivation. Generally speaking, because industrial robots are mostly used in industrial production processes, only according to a specific application to mechanically complete a production task, so it does not have a high degree of intelligence, in the change of the production task requires manual modification of the content of the program manually, but also need to manually carry out regular maintenance and maintenance, in order to extend the service life of

the machine. With the development and application of artificial intelligence technology in recent years, in order to reduce the artificial input capital, to achieve the whole industry chain automated production, industrial robots also gradually have a certain degree of intelligence, and with the development of technology, the degree of its intelligence is constantly improving [1].

3. The significance of the application of industrial robotics in the textile industry

In recent years, the rapid development of the tertiary industry has changed people's concept of choosing a career, which has led to the traditional manufacturing industry in the current labour environment, recruitment difficulties, high labour cost input phenomenon. And for the textile industry, part of the textile technology requires a certain period of training for production personnel before they can formally enter the production process. Especially people's living standards improve, the market also puts forward higher refinement requirements for textile products. Therefore, for the traditional manufacturing industry, the use of industrial robots to reduce production costs is an effective way to solve the current production difficulties. With the continuous development of big data, artificial intelligence and the Internet of Things and other digital technologies, industrial robots have been initially with a certain degree of intelligence, in a better convergence of the production process at the same time, but also let the industrial production has been a certain guarantee.

Comprehensive view of the current industry development trend, industrial robots and standardised industrial production lines with a high degree of adaptability, not only to reduce the human labour costs, but also to ensure the quality of product production. This is because the textile industry production line usually has a continuous, multi-link, multi-process characteristics of the personnel of the collaborative ability to have high requirements, so if a production link personnel problems, not only will affect all the subsequent production process, but also on the quality of the product production will be adversely affected. Industrial robots do not need to consider these issues, in the artificial intelligence and the coordination of the relevant computer programmes, industrial robots can perfectly connect all the production process, so that the production efficiency and quality of production to be guaranteed. For example, in the cotton textile industry, automatic cylinder technology, automatic yarn falling technology and self-adjusting levelling technology, not only can produce better quality cotton textile products, but also to ensure the cleanliness of the workshop production environment, effectively guarantee the quality of textile products [2].

4. Intelligent development status of the textile industry

At present, China's textile industry has initially achieved intelligent manufacturing, and is changing to the whole industrial chain intelligent production. And intelligent production so that the scale of China's textile industry has been in the forefront of the world, as of 2021, China's textile industry accounted for more than 50% of the world, is a deserved textile trade power. And China's textile industry has a more complete product industry chain, especially in recent years, China's aerospace industry and military medicine and other industries under the background of the booming development of high-performance industrial textiles market demand is rising year by year, promoting China's intelligent textile industry industrial change. At present, the textile production process has initially achieved the numerical control of key production processes, the overall coordination of the entire textile production process. In the subsequent development process, intelligent production and service will become the main trend of the intelligent development of the textile industry, and the main driving force for the construction of the whole industry chain collaborative textile intelligent ecosystem [3].

5. Industrial robots in the textile industry application pathway

5.1. Spinning automatic yarn drop robot

The spinning yarn drop work link is an important part of the spinning yarn production workshop, and the main purpose of this work link is to remove the impurities in the yarn by winding the yarn on the cylinder tube to set the shape. In the traditional manual production process, the yarn drop production team generally consists of 4-6 people, through the coordination of the team members, to complete the dialing, loading, tube insertion, head, tube pressure, and other work, and ultimately spinning cotton products. From the traditional production process, not only on the manual operation ability of the higher requirements, but also requires a high degree of coordination of the production team personnel with the ability to co-ordinate. The emergence of automatic yarn dropout robots, not only without the work of many people can complete the whole process of co-ordination, but also to enhance the safety of cotton production and production efficiency. The working process of the automatic yarn dropping robot is as follows: when the tube is full of yarn, the robot will use the robotic arm to grab the tube and place it in the yarn basket, and at the same time, the empty tube will be arranged quickly on the spindle to carry out textile production. Compared to manual production, you can achieve a one-to-many production situation by increasing the robot's robotic arm to achieve a doubling of production efficiency. At present in China's textile industry, there are three main applications of automatic yarn dropping robot. The first is the Songbao intelligent yarn dropping machine, the robot through the application of flying shear subroutine and cooperative control device to achieve vertical plucking, can effectively improve the accuracy of the barrel tube positioning, reduce the possibility of failure in the production process. The second type is the yarn drop trolley, this robot needs manual assistance when moving. The advantage of this robot is that it can simulate the manual rotation of pre-loosened yarns in the tube pulling process, which can effectively avoid the wear and tear of yarns in the production process. The advantage of the third type of robot is that the yarn pulling process is softer, does not cause wear and tear on the yarn or spindle, and also has a higher production efficiency in yarn pulling.

5.2. Robots for automatic packing of cylinder yarns

Cylinder yarn refers to a kind of packaging of yarn, named because it will be wrapped around the yarn in the sand cylinder. The workflow of the automatic cylinder yarn packaging robot includes automatic bagging, sealing, weighing, marking and flow and other links. Take coneBot-I automatic packaging robot as an example, the robot is mainly composed of mechanical parts such as cylinder yarn transfer device, bagging robot, bag sealing robot and transfer device. Its workflow is: the use of conveyor belts will be produced in the winding machine cylinder yarn transported into the packaging machine, the robot's robotic arm will be in the relevant applications and intelligent recognition function, the help of the cylinder yarn will be loaded into the inner layer of film bags and the outer layer of fibre bags, and then transported to the encapsulation of the mechanical part of the mechanical organisation, the robotic arm will be the sealing of the bag operation. After sealing, a conveyor belt transports them to an intelligent weighing table for weighing and printing production and product information on the package surface, and then transports them to the logistics robot for logistics transport. In the whole operation process, the fully mechanised operation process, with the help of intelligent programs and related technologies, reduces the wear and tear on the roving during the production process, and also reduces the possibility of information discrepancies or missing information in the production-logistics transport process.

5.3. Automatic roving dropping robot

The roving automatic yarn dropping robot is mainly composed of travelling device, pick-and-place manipulator, full yarn lifting manipulator, empty tube conveying system and track system. The travelling system is mainly activated by programmable logic controller (PLC) control, and carries out displacement movement according to the fixed step value set by the system. The pick-and-place manipulator is the core component of the roving automatic yarn dropping robot, and the production efficiency and quality of the robot are closely related to the positioning value accuracy of the pick-and-place manipulator. Full yarn lifting robot, empty tube conveying system and track system three components mainly through the network interaction information to achieve the synergistic operation between different systems, so that the robot can achieve accurate and fast roving drop yarn production work. It should be noted that the roving automatic yarn falling robot with a high degree of adaptability, not only with most of the textile manufacturing machine, but also through the old roving machine for technical transformation to get the relevant production efficiency.

5.4. Inspection robot

In the context of modern development, robots have been used in all walks of life, for the textile industry, the use of robots is more extensive. For example, testing robots is one of them, compared with the traditional manual analysis, the use of robot testing can not only effectively guarantee the quality of textile production, strengthen the semi-finished products and product testing effectiveness, but also to reduce labour costs. In the specific work, the factory only needs to use the robot can sense and analyse the current production situation in a timely manner, to complete automated management. At present, the detection robots mainly include the following: First, the appearance of the cylinder yarn detection, the product in the process of conveying to the packing process, with the help of the machine to detect the target area, so as to capture the image of the scene through the imaging device, and the use of the system to identify the image to determine whether there is anomalies in the appearance of the appearance of the detection to find out the defects of the cylinder yarn and complete the statistics to help the factory to achieve the quality requirements. Secondly, colour quality inspection. Second, colour quality inspection. After the drying and dyeing is completed, the spatial quality inspection equipment will scan the target area from the bottom up, and the robotic arm will trigger the imaging equipment to take on-site photos after identifying the target and analyse the quality algorithms to ensure that the target production will not produce a colour difference. The whole process of the system will automatically collect data information and generate inspection results. Third, fabric defect detection. After the completion of fabric production, it will be passed to the subsequent process, the process of robotics will trigger the imaging module to shoot the area, to carry out automatic detection, analysis of whether there are defects in the area, to determine the type of defects, and then help the staff to carry out the subsequent repair and optimisation, and effectively reduce the difficulty of quality inspection.

5.5. Logistics robot

The main purpose of the application of logistics robots is to transport the raw materials needed in the production process, the production of semi-finished materials and the final production of finished products to the designated location. Therefore, logistics robots are also in addition to service production robots, the most important part of the textile production process. With the development of digital technology, the entire process of unmanned automatic packaging and transportation has been preliminarily realized in textile production workshops. In the prevention and

control process, logistics robots mainly include bag loading and unloading robots, barrel transfer robots, roll loading conveyor robots and the whole loading palletising robots. One of the main tasks of the bag loading and unloading robot is to produce materials such as cotton bags, woven yarn bags, and use woven bags or plastic bags. Generally speaking, the packaging link usually has a variable order of placement, workload and other characteristics, so usually need to cooperate with other related mechanical devices for transport and movement. The main work of the drum transfer robot is to transport semi-finished products in drums to the designated production site. Since the products transported are mostly rounded barrels or caged containers, the transfer robots are often equipped with a loop or boom-locking end-effector structure to facilitate operation. The roll handling robots transport relatively lightweight, cylindrical and rotating tubes, and are therefore equipped with gripper arms for this purpose. The full palletising robots tend to transport large mass, regular square shaped boxes, so their end-effector is mostly operated with a lifting or hanging arm [4].

6. Conclusion

In summary, in order to achieve the intelligent transformation and upgrading of the textile industry, the application of industrial robots is the key development trend of the textile manufacturing industry in the future, industrial robots not only have the advantages of low application cost and high production efficiency, but also an important source of power to achieve industrial breakthroughs in textile production in the future and to promote industrial change, therefore, the relevant researchers should continue to make research and breakthroughs in technology and application. Therefore, the relevant researchers should continue to make research and breakthroughs in technology and application, so as to help the development of the industry.

References

[1] Zheng Xiaohu, Liu Just, Chen Feng. Intelligent development of textile industry[J]. Textile Journal, 2023, 44(08): 205-216.

[2] Zhang Jie, Xu Chuqiao, Wang Junliang. Research progress on data-driven intelligent control system for robotised textile production[J]. Textile Journal, 2022, 43(09):1-10.

[3] Feng Yingjie, Jiang Gaoming, Peng Jiajia. Artificial intelligence leads the innovation and development of textile industry [J]. Modern Textile Technology, 2021, 29(03):71-77.

[4] Liu Chang. Discussion on industrial robot sorting technology based on machine vision[J]. Popular standardisation, 2023, (22):42-44.