The "1 + X" Robot Technology Application Research Promotes The Reform Of Talent Training Mechanism

Meidan Liao

A Thesis Submitted in Partial Fulfillment of Requirements for

degree of Master of Engineering in Electrical and Computer Engineering

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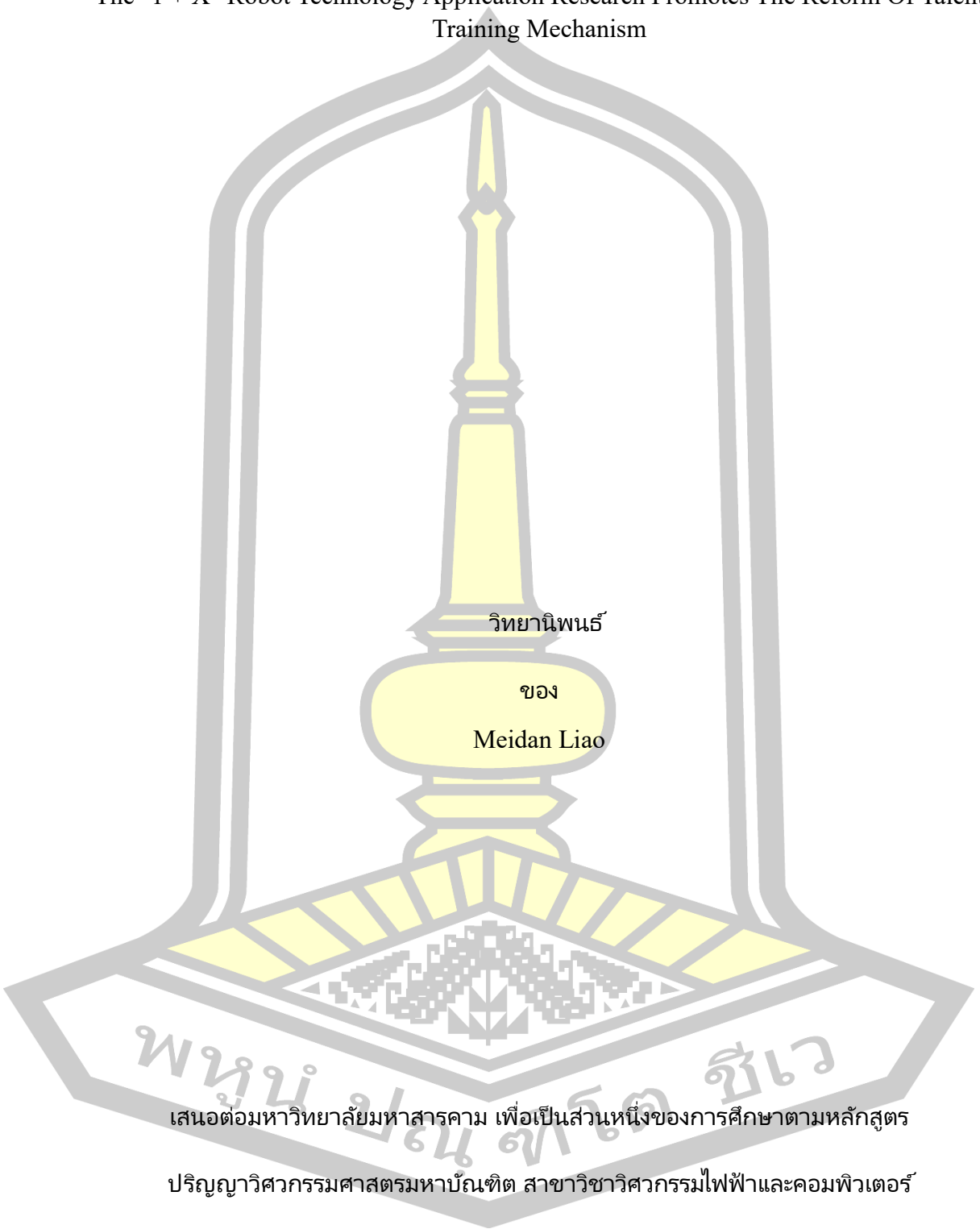

วิทยานิพนธ์

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The examining committee has unanimously approved this Thesis, submitted by Ms. Meidan Liao , as a partial fulfillment of the requirements for the Master of Engineering Electrical and Computer Engineering at Mahasarakham University

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TITLE The "1 + X" Robot Technology Application Research Promotes The Reform Of Talent Training Mechanism

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ABSTRACT

In the context of the “1 + X” certificate system, this study examines the reform of the training mode for industrial robot professionals at Guangxi Modern Polytechnic College. Focusing on intelligent storage and vision technology within the “1 + X” robot equipment framework. This research explores the significance of “1 + X” robot technology application in the reform of talent training mechanisms, aiming to equip students with professional skill level certificates, enhance their professional awareness, and improve their comprehensive application abilities. The outcomes of this training initiative have demonstrated its efficacy in facilitating a significantly higher pass rate among students. In the year of 2022, 90 percent of the examined cohort, comprising 18 out of 20 students, successfully achieved passing scores and get intermediate certificate. Furthermore, this approach is expected to boost student employment and career development, facilitating the achievement of high-quality training goals in the industrial robot technology field.

Keyword : "1 + X" certificate system, "1 + X" robot technology application, intelligent storage, visual technology, talent training education transformation

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1.1 Background and basic principle research

In recent years, China has gradually changed from a manufacturing power to a manufacturing power, with the rapid development of information technology and artificial intelligence technology. The proposal of Made in China 2025 has set off an upsurge of intelligent manufacturing, and has also raised the status and role of robots to a higher level. Robot technology is a burgeoning subject, which plays an increasingly important role in automobile, machinery, electronic manufacturing, food processing, service and other fields.

With the improvement of living standard and the progress of science and technology, the types and quantities of robots used in daily life and service industry have risen sharply. In industry, robots can also replace the workers' processing, assembly, handling, palletizing and packaging in most industries, thus solving the problem of shortage of human resources and improving production efficiency and quality of life. According to the data analysis compiled by Prospective Industrial Research Institute of National Bureau of Statistics, the annual sales volume of industrial robots in China ranks at the forefront of the world, and it is the largest consumer of industrial robots in the world. Nowadays, industrial robots have been used in various industries on a large scale. Combined with artificial intelligence and big data technology, intelligent robots have brought great benefits to the manufacturing industry, paved the way for the realization of intelligent factories in the future, and put forward higher requirements for the training, quantity and quality of industrial robot professionals.

From the successful experience analysis of foreign vocational education, it is found that the "modern apprenticeship system" in Switzerland and the "dual system" in Germany are both talent training modes with the combination of production and

education, multiple allocation and multi-certificate system. "Dual system" education means that enterprises and schools jointly undertake the task of training talents, and organize teaching and job training according to the requirements of enterprises for talents. The modern apprenticeship system in Switzerland also follows the core spirit of combining education with training. The successful implementation of the modern apprenticeship system has important enlightenment for our country.

Theory and practice are closely combined and teaching and practice are seamlessly connected. In 2014, the Ministry of Education, PRC proposed to deepen the integration of industry and education and school-enterprise cooperation, further improve the school-enterprise cooperation education mechanism, and innovate the training mode of technical and skill talents.

After repeated studies on the experience of other countries, in January 2019, The State Council issued the Implementation Plan for the National Vocational Education Reform (Article 20 of Vocational Education), proposed to deepen the reform of training mode for complex technical skills talents, and then started the pilot work of the system of "diploma + some vocational skills grades Certificate" (referred to as "1+X" certificate).In April of the same year, in the "Pilot Program for Implementing the System of "Academic Certificate + Several Vocational Skills Grades Certificates" in Colleges and Universities", it put forward clear guiding opinions on the integration of certificates into the professional talent training program and curriculum reform.

With the implementation of the "1+X" certificate system, the application of industrial robot technology has also become an important pilot object. It covers many types of certificates, such as operation and maintenance of industrial robots, application programming of industrial robots, assembly and adjustment of industrial robots, and integrated application of industrial robots. It involves technical knowledge of many disciplines, and plays an important role in deepening the reform of training mode and evaluation mode of compound technical and technical talents, expanding students' employment and entrepreneurial skills, and promoting students' high-quality

employment. Therefore, it is of great significance to study the application of robot technology under the "1+X" certificate system. The research steps are as follows:

(1) Collect, study, sort out and summarize literature data, pay attention to the development trend of robotics, understand the development of industrial robot industry chain and the technical needs of job talents.

(2) Formulate the "1 + X" certificate training program, adhere to the talent training mode of "industry-education integration, school-enterprise cooperation", and invite technical engineers of Jiangsu Huibo Robot Co., Ltd. to provide cooperative guidance and on-site technical assistance; Establish a "double-qualified" teaching team, further study of "1 + X" certificate system and professional qualification standards, to the talent training scheme, curriculum standards, skills competition standards and post talent technical requirements, with professional skill level standard leading talent training plan and curriculum system upgrade, form the "1 + X" certificate system "degree + strengthening + supplement + expand" education teaching mode, developed the industrial robot "1 + X" course module content, "post class certificate" accommodation, can build a new industrial robot programming and operation course resource system.

(3) Conduct "1 + X" certificate assessment and training. After the selection of certificate personnel, carry out short-term certificate assessment training. Training mainly by "1 + X" robot equipment as the research carrier, learning "1 + X" ABB machine technology application equipment contains interdisciplinary technology, especially the visual technology, information interaction technology, storage space location data analysis and other technical knowledge, enable the students to fusion and application of interdisciplinary technology, in the learning process for validation design program, experimental data, can design a more optimized, more reasonable program, In order to expand the study of subject knowledge, it can more effectively improve students' application level of robots and promote the implementation of the "1 + X" certificate system.

(4) After the certificate assessment, the data collection and data collation of the whole training were carried out, and a questionnaire survey was conducted on the students who obtained the certificate to summarize the training effect and analyze the students' learning results, and feedback the effectiveness and effectiveness of the "1 + X" robot technology application research on the talent training reform.

(5) To sort out the research mind map, form the paper results, and complete the paper writing.

1.2 Research objectives

The strategic planning and deployment of "Made in China 2025" is deeply rooted in the hearts of the people. Driven by the trend of informatization, modernization, intelligence and new development pattern, the R&D and industrial application of robots have become one of the important parameters to measure a country's scientific and technological R&D level and the future development prospects of manufacturing industry. The transformation from automation to intelligence is the overall goal of robot technology development, and the quality requirements of technical development talents are greatly improved. It takes a lot of manpower, material resources and financial resources to cultivate talents with new compound skills.

Vocational colleges are a major channel for talent transportation in China, and the proposal of "1+X" has put forward clear guiding opinions for the education reform, professional talent training scheme and curriculum reform. This research mainly relies on the continuous growth of the industrial chain, the significant improvement of the technical level and the gradual refinement of the integrated system. Combined with the research equipment, the research objectives are as follows:

(1) Study the "1 + X" certificate system and the examination process of the "1 + X" industrial robot application programming professional skill level certificate;

(2) Study the application of "1 + X" robot technology. Taking the visual and intelligent storage contained in the "1 + X" robot technology equipment as an

example, we analyze the learning and application of technology, so that students can effectively integrate the knowledge of multiple disciplines, expand the technical knowledge of disciplines horizontally, break the discipline barriers, and improve the comprehensive application ability.

(3) It can promote the reform of talent training mode. Combined with "1 + X" certificate system and vocational education reform mechanism, the analysis of robotics application key technology and industry development path, through the "1 + X" certificate examination training process and "post class card" financing, improve the vocational education training level, promote the cultivation of robot technology talents, promoting the formation of robot technology application and talent training mode reform exemplary role.

1.3 Research scope and limitations

This study mainly starts from teaching, learning, production, research, post, competition and certification, analyzes the key technologies and difficulties in the application of robotics technology, integrates interdisciplinary and multi-directional development, and promotes the robot "1+X" certificate system and a new mode of talent training. The research scope is mainly under the "1+X" certificate system:

(1) How to use the intelligent algorithm to grab and place the objects in the two-dimensional storage space

(2) How to combine visual hardware and software for object image processing and recognition to realize the communication between robots and vision;

(3) How to complete the system programming and system control of the whole equipment;

(4) How to build a new training mode for robot technical talents in line with the development of vocational education?

However, limited by the choice of robot types, application occasions and technological innovation, traditional robots can no longer meet the current needs.

Cooperative robots, service robots and other products have emerged in response to the situation. Robots can be used in medical treatment, agriculture, family, logistics, etc., and their ability, accuracy, flexibility and safety are constantly improved. During the research process, it is found that although the ABB "1+X" robot equipment used has been updated, the technical application research is still limited by the following three points:

(1) The modularization and integration of "1+X" ABB robot equipment reduces the space occupation and cost, and involves a wide range of knowledge disciplines. However, in the process of performing work, the robot is only suitable for tasks with a fixed trajectory, and it does not have the recognition function itself. It is necessary to connect peripheral vision equipment for communication to recognize the position, size and color of objects, so as to gain the perception of the external environment.

(2) There are few warehouse locations in the storage module, so the research on the analysis and practical detection of the warehousing position of intelligent storage materials is limited, and the storage position data analysis and detection can only be carried out by means of material space stacking.

(3) ABB "1+X" robot equipment is used. The brand technology learning is single, and the technology application is mostly limited to ABB robots. The research and practice of technology application of other brands are lacking, and the joint debugging of the whole equipment is also a big difficulty.

1.4 Expected Effect

This research involves "1+X" certificate system, vocational education reform, application of robot technology, talent training mode, etc. Through research and analysis, the expected results are as follows:

(1) It has popularization and reference. It can be used as a reference for the pilot colleges involved in "1+X" robot certificate system research and certificate examination. The real implementation of vocational education reform research can

provide implementation experience and reference for the implementation opinions of talent training mode reform in vocational colleges.

(2) Form a curriculum construction system. The idea of curriculum system integrating teaching, learning, production, research, post, competition and certification is formed, which provides a new path for reconstructing the teaching content of industrial robot specialty.

(3) Implement the certificate system. Studying the application of robot technology under "1+X" certificate system can directly implement the pilot work of "1+X" industrial robot certificate system, and deepen the reform of training mode of compound technical and technical talents in national vocational education.

(4) Improve the technical level. By studying the application of robot technology, expanding subject knowledge, integrating subject technology, developing skill level in many aspects, breaking down subject barriers, and applying robot technology into practice in an integrated, systematic and effective way, it also lays a foundation for further technology development and intelligent manufacturing development.

(5) Form the paper results. After repeated consulting, studying, analyzing, summarizing and revising, the paper "Research and Implementation of Robot Technology Application under" 1+X "Certificate System" was formed, which can be published publicly and has certain research reference value.

Chapter 2 Literature Review

2.1 Introduction

With the rapid development of China's industry, industrial robots and PLC are already commonly used technologies in the field of industrial automation. Industrial robot technology is a kind of humanoid operation, through computer programming, can achieve automatic control, complete various operations in three-dimensional space, achieve mechatronics and automation of production equipment, to achieve mass production, improve product quality and production efficiency. PLC is a computer control system used to control and monitor the production process. It is programmable and flexible, can adapt to different control requirements, usually used to control production lines, factory equipment and automation process, can achieve logical control, sequence control and sensor feedback functions.

The "1 + X" industrial robot equipment includes robot technology, PLC technology, three-dimensional library, shift machine, visual detection and other modules, which can be assembled to realize the intelligent detection and assembly of industrial robots. In the "1 + X" industrial robot equipment, the robot can be programmed, so that the robot can replace the human material handling, palletizing, assembly and other typical work according to the planned work process. The PLC is used to configure and program HMI, RFID, rotating feed, shimachine, sensor signal control and other modules, establish the communication between PLC and industrial robots, and realize the intelligent detection and assembly control of industrial robots.

The integration of the industrial robot and PLC technology can effectively improve the safety, reliability and anti-interference of the industrial robot control system, and realize the electromechanical integration of the industrial robot system. It is believed that in the future development, PLC technology will have a better application in industrial robots, and promote the progress of industrial production.

Research has found that until now, the vigorous development of "intelligent manufacturing" has provided a clear direction for the development and renewal of China's manufacturing industry. Industrial robots, as a sharp tool to solve the problem of "labor shortage" after the decline of China's "demographic dividend" in China, also shoulder the important responsibility of leading China from a manufacturing power to a "smart" manufacturing power. Under the background of "Made in China 2025", China's higher vocational colleges are scrambling to open industrial robot technology majors, and how to cultivate a large number of high-quality industrial robot new composite talents is very important. As a pilot school of "1 + X" industrial robot application programming vocational skill level certificate, we have introduced 20 sets of "1 + X" equipment, which can not only provide a place for certificate assessment, but also promote our talent training.

2.2 The "1 + X" certificate system

Based on the new normal of economic development, General Secretary Xi Jinping has discussed the development of vocational education for many times, and put forward new ideas, new ideas and new viewpoints.

In January 2019, The State Council issued the Implementation Plan of National Vocational Education Reform (i. e., 20 articles of vocational Education), proposing to deepen the reform of the training mode for complex technical skills personnel, and launch the pilot work of "academic certificates + several vocational skill level certificates" (referred to as "1 + X" certificate) system. In April of the same year, the Ministry of Education and other four departments issued the Pilot Program on Implementing the System of "Academic Certificate + Certificate of Several Vocational Skill Level" in Colleges and Universities, which put forward clear guidance on the training plan of professional talents and curriculum reform. So what is the specific "1 + X" certificate? How should we implement the "1 + X" certificate?

The connection and integration of documentary evidence is the essence of "1 +

X", among which "1" is the academic certificate, which refers to the diploma obtained by the learners in the school or other educational institutions in the educational system; "X" is a number of vocational skill level certificates. "1" is the foundation, and "X" is the supplement, reinforcement and expansion of "1". In a word, the "1 + X certificate system" means that students obtain a types of vocational skill certificates while obtaining academic certificates. Only the colleges and universities that have declared the pilot of 1 + X certificate system through the Institute of Vocational and Technical Education Center of the Ministry of Education can apply for the certificate assessment base and open the certificate assessment work.

There are three levels of primary, intermediate and advanced, among which the primary mainly evaluates the basic operation and typical application programming of industrial robots, the intermediate mainly evaluates the site programming, offline programming, external equipment programming, system comprehensive application and other aspects, and the advanced mainly emphasizes the technology development and design ability. They can apply for the first-class grade assessment every year. Pilot universities approved by the Ministry of Education can only apply for the certificate assessment task to Beijing Sai Yuda Science and Education Co., Ltd. and can open the assessment after passing the examination. Each level assessment is divided into two links: theory and practical operation, but in 2021, the new safety test and assessment links, now there are three assessment links. If one link in the theory, practice and safety test fails, the certificate cannot be obtained at present, but the results will be retained for one year, only the link that fails to pass the make-up examination in the next year. Only after the examination is passed can we obtain the certificate, and Beijing Sai Yuda Science and Education Co., Ltd. will monitor and input the results, and issue the certificate. The specific process is shown in Figure 1.

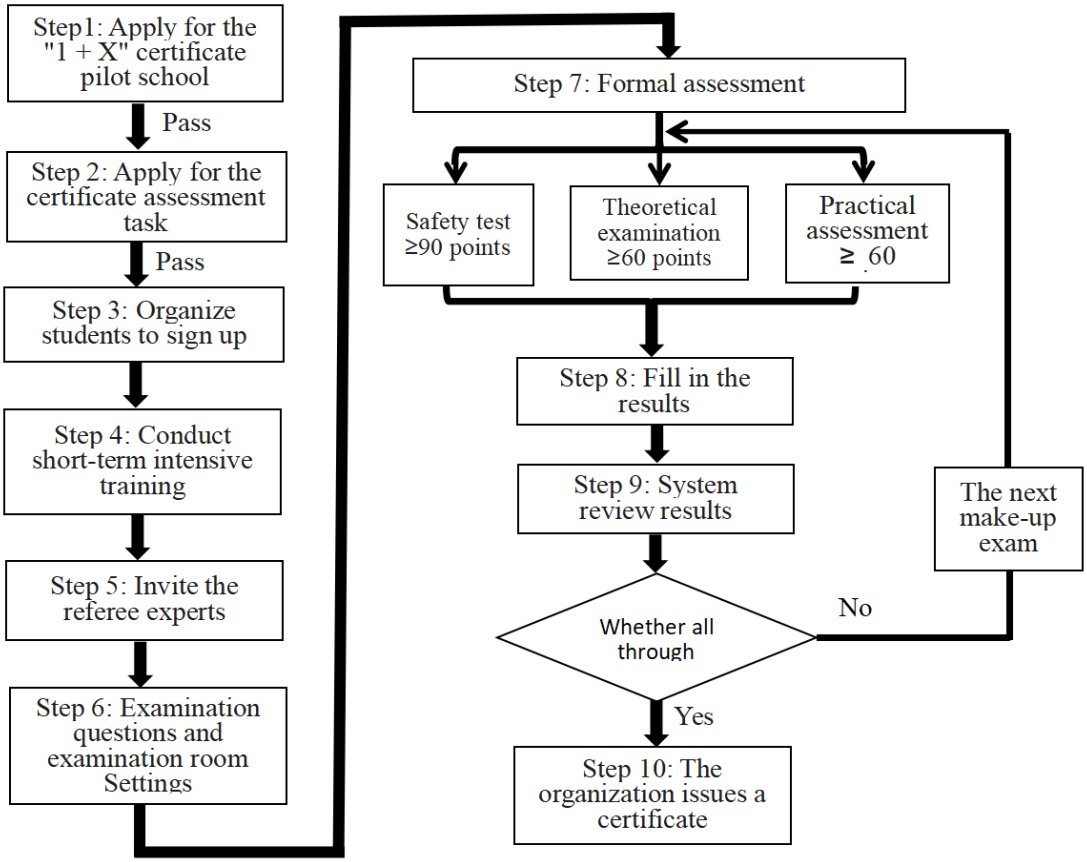


Figure 1: The examination process of "1 + X" certificate

After searching hundreds of relevant literatures on various academic websites, There are more than 50 articles related to the "1+X" certificate system, vocational education reform, intelligent manufacturing development, industrial robot technology application, robot technology application under the "1+X" certificate system, studied more than 40 articles, made a general review of relevant research, and decided the research direction. In the process of research, it is committed to find a more suitable training mode for industrial robot talents which integrates teaching, learning, production, research, post, competition and certification.

2.3 The Development Course of Industrial Robot Technology in China

China's industrial robots started in the early 1970s, and can be roughly divided

into three stages:

The first stage: In the late 1970s and early 1980s, under the promotion and advocacy of Professor Jiang Xinsong, director of Shenyang Institute of Automation, China conducted the first exploration and research in robotics, and made some breakthroughs in the robot control algorithm and principle design of control system.

The second stage: In the 1980s, under the impact of the wave of high technology, with the deepening of reform and opening up, the development and research of robot technology in China has been valued and supported by the government, and a variety of industrial robots such as arc welding, spot welding and spraying have been successively launched. With the support of the National 863 Program in the 1990s, China has the ability to independently design and produce industrial robots, and has developed industrial robots for various uses such as assembly, handling, packaging and palletizing, and successfully developed a number of special robots.

The third stage: in the 21st century, China's industrial robot development has entered a new stage, but after years of accumulation, international brands have been through the upstream and downstream industry chain, domestic robot manufacturers because batch small upstream parts procurement does not have price advantage, no downstream industry chain support, domestic robot faces huge challenges.

Now, the domestic industrial robot industry has been gradually subdivided, and the application field is gradually expanded. Under the guidance of "China Intelligent Manufacturing 2025", with the effective cooperation of new technology, new technology, Internet and industrial robots, the development of industrial robot industry will be transformed from "manufacturing" to "intelligent manufacturing", which also puts forward higher requirements for the cultivation of industrial robot technical talents.

2.4 Main contents of literature review

The manufacturing and application level of robots represents the manufacturing

level of a country. In foreign countries, the development of industrial robot technology started early, the technology research and update were fast, and it gradually formed a world-famous brand, among which ABB in Sweden, FANUC and Yaskawa in Japan and KUKA in Germany were the most representative, and were widely used by industries all over the world.

The application of industrial robots in our country started late, and the development and production process is short. Although under the trend of automation of the emerging industries, the growth of the upstream industrial robot industry, with the upgrading and transformation of the downstream industries facing the opportunity of rapid industrial development, but also facing the challenges of training and transportation of high-tech talents.

In 2019-2025 China's industrial robot industry target market selection strategy research report, a detailed analysis of the development trend of robot, enterprise market analysis, market strategy and selection strategy, also see in the market research report of China robot sales growth trend, sales compound growth of more than 20% as shown in Figure 2, data source: intellectual research consulting released the 2018-2024 China's industrial robot industry market depth research and future development trend report.

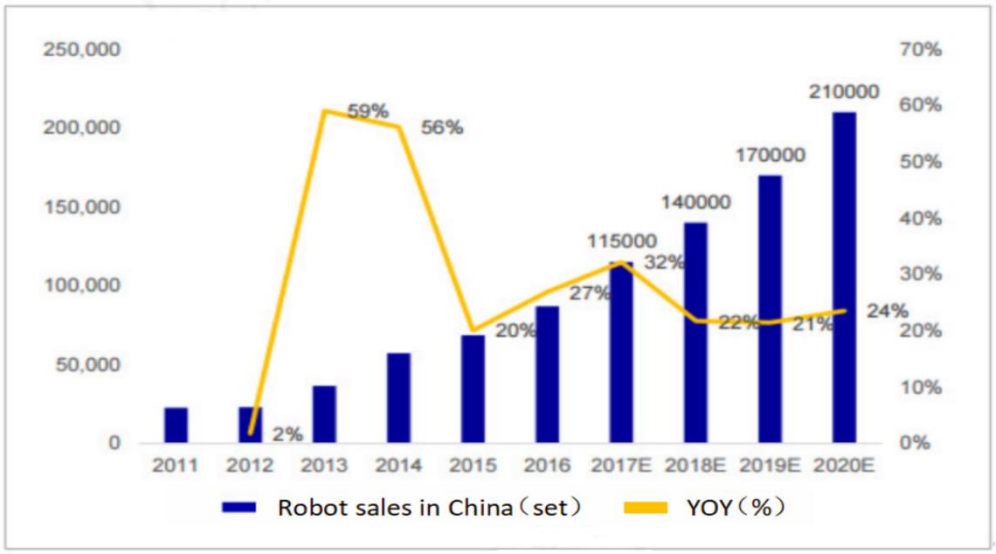


Figure 2: Annual compound growth trend of sales in China's robot industry

By 2022, China has become the world's largest consumer of industrial robots for eight consecutive years, and "machine generation" has become the key to the transformation and upgrading of China's manufacturing industry. The "14th Five-Year Plan for Robot Industry Development" jointly issued by 15 departments including the Ministry of Industry and Information Technology clearly states that by 2025, China will become the source of global robot technology innovation, the gathering place of high-end manufacturing and the new highland of integrated application. Technology research and development and update cannot be separated from high-tech, high-level and high-quality talents. Vocational education, as a major front of talent transportation, plays an important role in promoting the intelligent development of industrial industries.

Referring to the experience of German "dual system" and "modern apprenticeship system", the "1+X" certificate system proposed in 20 vocational education in our country provides a way for vocational education reform. Therefore, it is an important measure to deepen the training mode of robot compound technical and technical talents by establishing and studying the technical application and reform implementation of robots under the "1+X" certificate system, and it is also the subject direction of this paper.

The application of industrial robot technology involves a wide range of disciplines, including artificial intelligence, machinery, electronics, sensing technology, vision technology, data processing and other cross-integration. At present, machine vision has been widely used in automatic production, from object/bar code identification, product detection, appearance size measurement to positioning of mechanical arms and transmission equipment, there are different kinds of vision systems in operation. In this research, visual image processing is one of the key problems to be solved when studying the application of "1+X" industrial robot technology, and the other problem is the analysis of warehouse space position data. In the actual use process, pre-sorting and optimizing the workpieces in the

three-dimensional warehouse according to certain rules is helpful to reduce the complexity of the subsequent workflow and improve the work efficiency. After many times of design, research, analysis and summary, it is found that this is also applicable in robot applications.

Cultivating high-quality craftsmen from big countries is an important strategic resource of the country, and it is an inevitable choice for vocational education to achieve high-end development. In order to cultivate high-quality artisans in big countries and improve the quality of vocational education, we must innovate and reform the new training mode, and the comprehensive education mode of "on-the-job competition certificate" based on post requirements, skills competition ability requirements and "1+X" vocational skill level certificate standard is an effective way to cultivate high-quality artisans in big countries.

At present, four related professional skill level certificates have been issued in the field of industrial robot technology, which has promoted the "three education" reform of teachers, teaching materials and teaching methods of industrial robot technology, and also promoted the deep combination of professional construction and industry.

Through comprehensive analysis, it is found that the talents training and curriculum system construction of industrial robot technology application in vocational education are still being continuously improved and optimized, and the problems of integration of teaching, learning, production, research, post, competition and certification, and barriers of subject integration are still being explored. This is also the main idea of this research on robot technology application and the implementation of the reform mechanism of talent training mode under the "1+X" certificate system.

2.5 Conclusions of literature research

After repeated research and study of multiple documents, the required documents

are summarized as follows:

(1) The author of the first literature starts from the advantages of PLC technology, the author discusses the specific application of PLC technology in industrial robots, so as to provide several references for the subsequent application of PLC technology in industrial robots.

(2) The author of the second literature mainly analyzes the industrial robot industry development and talent training, the German dual vocational education mode has carried on the detailed analysis, after the new enlightenment, and combined with the present situation of Chinese vocational education built dominated by higher vocational colleges, government, enterprises, guild, comprehensive evaluation of teaching quality of talent training ideas, has certain reference value.

(3) The author of the third literature analyzes the concept of "Internet + vocational education" in the Implementation Plan of National Vocational Education Reform, starts with the essence of vocational education modernization, tries to analyze the connotation of "Internet + vocational education", expounds the development ideas and strategy of "Internet + vocational education" from four aspects, explores the new law of "Internet + vocational education", promotes the deep integration of information technology and education teaching; cultivates the new mechanism of "Internet + vocational education" to promote resource sharing and balanced development. It understand the diversity of national vocational education reform, which is of reference value for the study of education model in the new era.

(4) The author of the fourth literature mainly study and interpret the pilot program of the system of "academic certificate + several vocational skill level certificates" in colleges and universities, clarify the concept of "1 + X" certificate system, implement the implementation of the "1 + X" certificate system for the application of industrial robot technology according to the scheme, and practice the requirements of the national "1 + X" certificate system.

(5) Fifth literature from "prosperous China" about " 2019-2025 China's industrial

robot industry target market selection strategy research report, the report from the enterprise market selection strategy, robot industry development and present situation research analysis, market development strategy analysis, for the future industrial robot enterprise target market development put forward new Suggestions.

(6) The author of the sixth literature, Liu Xin. Starting from the direction of demand side and supply side of the industry, the paper analyzes the development, operation, policy environment, core link development and potential risks of China's industrial robot, which opens up new research ideas for the development of the industrial robot industry in the next few years.

(7) The author of the seventh literature detailed interpretation of the concept of modern apprenticeship and the importance of vocational education, to Britain, Germany, Switzerland, France, Australia's modern apprenticeship development path research, get modern apprenticeship to the development of vocational education in our country and reference value, for the modern apprenticeship strategy.

(8) Xu Xiaoyan of the 8th literature take the robot vision system technology course as an example, from the importance of visual technology, course teaching situation, curriculum reform, research under the "1 + X" certificate system, how to depth fusion professional skills standards and curriculum reform, put forward on the basis of the revised talent training plan, curriculum training target as the core, with "1 + X" certificate system reform innovation ideas.

(9) Huang Yanyan, etc. of the ninth literatures taking a six-warehouse three-dimensional warehouse as the research object, the method of advance sorting and optimization of the artifacts in the stereo warehouse is studied, and the programming and debugging verification with industrial robot and PLC controller, proposing a specific solution for the sorting problem of three-dimensional warehouse artifacts. This method is helpful to select data analysis of robot storage space.

(10) Ma Zhiguang of the 10th literature interpreted the meaning of "post class card" and the importance of talent training, the industrial robot, professional post,

class, card, four financing to build industrial robot programming, robot vision, industrial robot application course system, improve the students 'professional skills, professional quality and core competitiveness, and enhance students' understanding of the job.

(11) Luo Mingfeng etc. of the 11th literatures had an in-depth understanding of the professional education reform of industrial robot technology, analyzes the current situation of professional training programs, teachers and hardware facilities, and puts forward the talent training mode of "double cycle" construction jointly built by school-enterprise cooperation. Deepen the integration mechanism of industry and education, innovate new creative methods, and cultivate the required workers for enterprises Industry robot professional compound talents.

(12) Zhang Limei etc. of the 12th literatures describe the basic features and identification technology performance of RobotStudio, and study in detail how the tool is used in companies developing prefabricated automation solutions, especially in the food industry, and offer personal insights into the educational value of the software.

(13) Song chengxiu etc. of the 13th literatures discuss and introduce the application of robots and visual cameras in assembly lines in the context of industrial environment, especially with the increase of labor costs and automation rates.

(14) The 14th document is the "1 + X" certificate compiled by Beijing Saiuda Science and Education Co., LTD. It is from the practical point of view, for industrial robot application programming personnel, control the industrial robot application programming professional skill level standard, combined with the practical application of industrial robot common engineering projects, in the form of project, task finishing teaching content, make students learn the basic knowledge of industrial robot and operation, programming skills, is an important study of intelligent storage and visual references.

(15) Qiao Shumei of the 15th literature deeply analyzes the specific application

situation of mechatronics technology, and briefly discusses its development trend.

To sum up, we know from the above-mentioned complaints and other materials that vocational education plays an important role in China's education system, and it is a basic project to cultivate high-quality skilled talents. However, the horizontal integration and vertical penetration of vocational education in China have not yet achieved truly representative and substantial results. At present, the curriculum system and talent technology application training of industrial robot technology specialty in vocational colleges in China generally lag behind the development needs of industries and enterprises under the new situation, and the gap of high-tech talents is large, which is detrimental to the development of vocational education and the transformation of China manufacturing to "intellectual" manufacturing.

Therefore, based on the opportunity of vocational education reform and "Made in China 2025", this paper compares the development trends of robot technology application and vocational education at home and abroad, combines the pilot equipment of "1+X" industrial robot application programming certificate, integrates and optimizes resources, reconstructs professional curriculum system, and studies the reform and update methods of multi-disciplinary knowledge and talent training mode of robot technology application, so as to strengthen the vocational education of industrial robot technology specialty, speed up the construction of modern vocational education system, and make the trained talents develop horizontally and vertically.

Chapter 3 Research Method

3.1 Main study methods

Combined with the training and implementation of industrial robot technology professionals, practical teaching of professional courses, training of 1+X industrial robot application programming certificate, technical requirements of the post, skill competition, development trend of the application field and other mechanisms, the following methods will be adopted for the paper research:

(1) Literature research method. Consulting journals, searching web papers, collecting, reading and analyzing, interpreting the National Vocational Education Reform Implementation Plan (Article 20 of Vocational Education) of China's vocational education development, studying the "1+X" certificate system, analyzing the talent training mode of industrial robot technology major at home and abroad in recent three years, the implementation of the "1+X" system and related materials, and paying attention to the development trend of vocational education at home and abroad. Understand the research results and latest trends related to the application of robot technology, sum up the research results and experience, combine with the type of "1+X" certificate related to industrial robot technology, the construction and implementation of pilot bases, pertinently construct the professional course system of industrial robot technology supported by the certificate core, optimize the course content and technical skills training of talents, and analyze the application of robot technology under the "1+X" certificate system.

(2) Investigation and research method. I conducted a questionnaire survey and job interview with my own working colleges, other higher vocational colleges and enterprises with robot work, and finally selected enterprises with school-enterprise cooperation, schools with university cooperation, graduated students majoring in industrial robot technology, and students in classes with industrial robot technology

courses as the survey and interview objects. In this way, we can understand the requirements of enterprises for students' talent quality and job skills, master the implementation and achievements of "1+X" industrial robot technology certificate system in vocational colleges, and master students' ideas and learning effects of integrating industrial robot technology courses with "1+X" certificates, which will provide ideas and reference for the teaching reform and construction path of integrating courses and certificates, and pave the way for integrating courses and competitions with certificates.

(3) Comparative analysis research method. This paper analyzes the application development and sales volume of industrial robot technology in recent years, grasps the development trend and development direction of intelligent robot technology, compares the knowledge and application of robot technology involved in "1+X" certificate, analyzes the advantages and disadvantages of the implementation of "1+X" industrial robot certificate system, and analyzes the compatibility and adaptability between school talent training and enterprise talent demand, which is conducive to the reform of teaching and learning, and further optimizes the construction of professional course teaching system and talent training scheme.

(4) Practice method. Carry out theoretical analysis and technical application practice in course teaching, students' skill competition guidance, "1+X" certificate training and enterprise training, organically integrate the positions, courses, competitions and certificates related to industrial robots, make robot technology teaching and training plans, tap robot technology knowledge, benchmark the technical requirements of enterprises, analyze the applicability, feasibility and extensibility of robot technology under the "1+X" certificate system, and obtain corresponding practical results.

(5) Discussion method. In-depth cooperation between schools and enterprises, discuss and analyze the project application with enterprise technicians, understand the technical knowledge points, technical difficulties, technical emphases and technical

development points involved in the application of robot production lines, and optimize the training and transportation chain of school talents in combination with the demand of enterprise technical talents. Conduct thematic meetings between schools to discuss the implementation measures, process problems, process methods and final results of "1+X" industrial robot technology certificate, and promote the educational reform and development of vocational colleges. Conduct technical discussions with tutors and trainees, learn from each other, check robot technical problems in time, and accumulate learning and practical experience.

(6) Experience summary method. In the process of theoretical study and practice, induction, analysis, verification, refinement and summary are carried out, so that the whole robot technology knowledge system can be more detailed and systematic, and the technology application can be more feasible, adaptable, modern, efficient and extensible, thus forming one's own experience and promoting further technology development with more depth, breadth and height.

3.2 Research Work Process Plan

This time mainly takes the three-dimensional storage algorithm, visual detection and system comprehensive application analysis under the "1 + X" certificate system as an example to discuss their teaching, learning method and application in robotics application, and what substantive role can play in promoting the formation of a new mechanism of talent training reform.

From the aspects of policy interpretation, course construction, course learning, personnel selection, technical experiment, achievement embodiment, etc., the whole research process plan is formulated as shown in Figure 3.

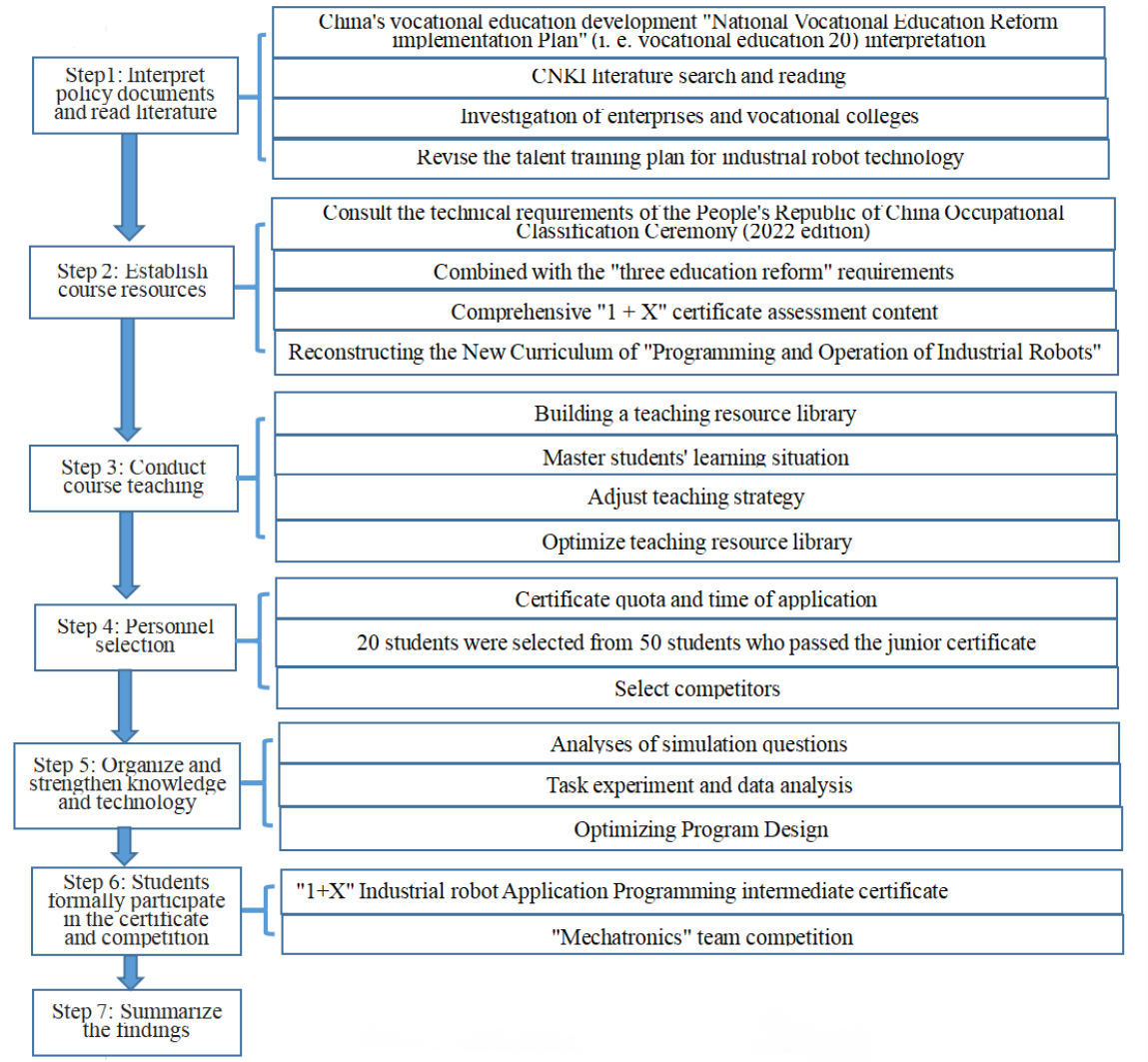


Figure 3: Researh Work Diagram

The first step is to interpret the policy documents and relevant documents about vocational education development, and refine the key parts. At the same time, the robot teacher team went deep into the school-enterprise cooperation, and adjusted and revised the new professional talent training program according to the requirements of the school's talent training program.

The second step, combined with the professional classification of the People's Republic of China (2022 edition) fair draft, "three teaching (teachers, teaching, teaching material) reform", "1 + X" industrial robot application programming professional skill level certificate system, to build the industrial robot programming

and operation curriculum standards and online library, convenient students learn anytime and anywhere, understand the industrial robot post development trend.

Step 3: Carry out the course teaching of "Industrial Robot Programming and Operation" in the fixed semester, adopt demonstration method, case analysis method, project task-driven method and other methods to implement each teaching task, summarize and reflect on the evaluation information of the classroom teaching process in real time, and adjust the teaching content and teaching strategy in time. At this stage, teachers can master the learning situation of students, and provide certain reference value for the selection of research and competition, and students can also lay the knowledge and skill foundation for the future "1 + X" industrial robot application programming professional skill level certificate assessment or skill competition.

Step 4: According to the application plan of the assessment quota and assessment time of the "1 + X" industrial robot application programming vocational skill level certificate of each year, During the semester of studying the course, The teacher selected a total of 50 students from two classes of industrial robotics technology (39 students) and electromechanical technology (46 students) to participate in the certificate training. Through the comprehensive results of the classroom performance, task completion, selection and assessment. After ranking from high to low, each of the 2 classes selected 25 students with strong ability and volunteered to participate in short-term training for primary certificate examination training. At the same time, we can also select students with strong comprehensive ability to participate in various vocational skills competitions. In the next stage, when applying for the intermediate certificate examination, the 50 students who have passed the primary certificate examination and the 20 students who have stronger ability and volunteer to participate in the intermediate certificate examination will be selected for short-term centralized training on ability improvement.

Step 5: in the research training, the teacher guides students to comb course

teaching knowledge, and with "1 + X" intermediate card simulation, for example, students group task experiment, data collection, experimental data analysis and experimental summary, the intelligent storage and visual part of the program optimization design, strengthen practice, shorten the task completion time.

Step 6: Students will formally participate in the certificate assessment and skill competition, and give feedback on the teaching effect.

Step 7: Summarize the research results.

3.3 Tools and equipment used

3.3.1 Robotics

In the school application to become the "1 + X" industrial robot application programming professional skill level certificate pilot base, cooperation with Jiangsu Huibo robot technology co., LTD., the school introduced 20 sets of primary certificate and intermediate certificate can be used robot integrated equipment, and according to the layout specifications, university-enterprise cooperation "1 + X" industrial robot teaching / textual research comprehensive training base as shown in Figure 4.

Figure 4: "1 + X" Industrial Robot Teaching / Research Comprehensive Training Base

Robot model is: ABB IRB120 six degrees of freedom of industrial robot, mainly consists of robot ontology, control cabinet, teach and connecting cable, with equipment other modules can complete industrial robot simulation welding, polishing,

drawing, stacking, simulation glue, assembly and other field programming work, aims to cultivate students' robot programming ability and system test, operation and maintenance ability.

3.3.2 Programable Logic Control PLC

As a bridge between visual and robot communication, PLC needs to build communication programs. In the "1 + X" equipment, if the "1 + X" industrial robot application programming professional skills primary level certificate, usually have been built with PLC related procedures, candidates only need to complete the program programming and debugging tasks of some robot tasks. If earning "1 + X" industrial robot application programming professional skill level intermediate certificate, in addition to the specified PLC environment, need candidates to learn to use training platform supporting TIA Portal V15 PLC software for PLC system control such as: HMI, rotating feeding, transformer, RFID module configuration and programming, establish the PLC and industrial robot communication, can configuration RFID, intelligent storage module HMI images, easy to the real-time monitoring of the robot working status, intelligent storage position information, be detected artifact category information and RFID read and write data.

3.3.3 Intelligent storage

Each equipment platform is equipped with an intelligent storage for storing materials or finished products. The storage module needs power supply 24V and connects the Ethernet communication interface to connect the photoelectric sensor at the bottom of each position. The intelligent storage module is shown in Figure 5, and the circuit diagram is shown in Figure 6.

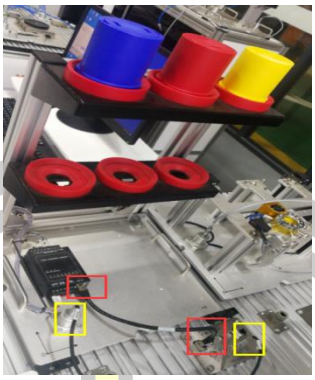


Figure 5: Installation diagram of the intelligent storage module

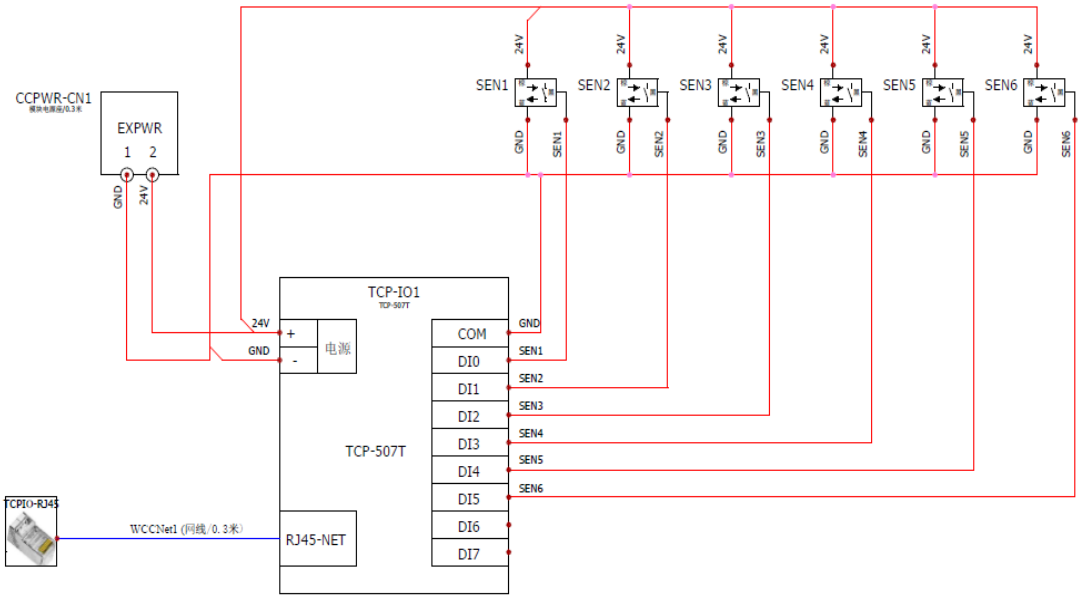


Figure 6: Circuit diagram of intelligent storage

In the "1 + X" robot equipment, when the position detects the material, the sensor will feed back the material signal to the material detection register, the robot will receive the signal and trigger the corresponding action, and reach the material signal position to pick up the material. When there is no material in the position detection, the robot can perform the storage of finished products according to the requirements of the storage position.

3.3.4 Camera

In the modern automatic production process, the industrial vision system is often

used in product quality detection, product identification, product measurement and other aspects. Each "1 + X" robot device is equipped with a loading and unloading visual camera system module. The visual camera system communicates with the robot through TCP / IP to identify the type, color, location and angle of the workpiece. Install the vision software In-Sight Explorer for artifact visual learning training. After connecting the visual camera network, the camera focal length, exposure, image brightness, light source intensity and other parameters are adjusted, so that In-Sight Explorer can take clearer workpiece graphics and obtain more accurate artifact graphic data. Image effects displayed before and after adjusting the visual camera parameters are shown as shown in Figure 7.

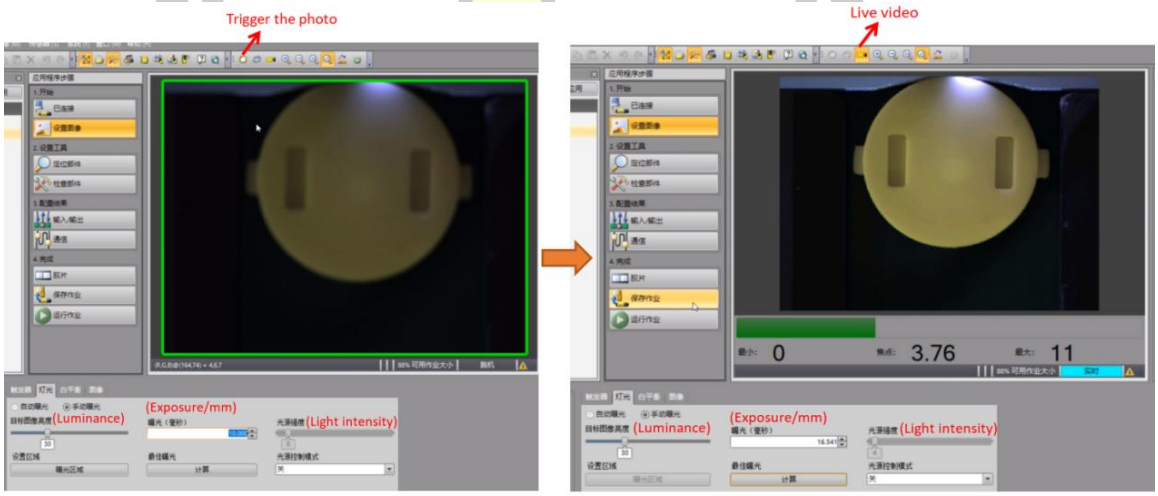


Figure 7: Reference to the image effect before and after adjustment of visual camera parameters

3.3.5 Robot software

With the increase of courses related to robots, the contradiction between the rapid growth of the number of students and the imbalance of teaching equipment resources is increasingly prominent, and the lack of equipment cannot meet the learning needs of each student. ABB's RobotStudio simulation software can simulate real scenes and achieve the same demonstration effect as the actual workstation or production line. RobotStudio Can be used to improve the efficiency and accuracy of

robot programming, and reduce downtime, it also has a role in remote maintenance, troubleshooting, risk management and education. Install RobotStudio simulation software on PC to facilitate students to learn and verify their knowledge and skills in class, which is conducive to group and layered teaching; but also facilitates students to learn anytime and anywhere, and improve their independent development and innovation ability.

For intelligent storage learning, for example, can use RobotStudio simulation software according to the actual environment to build virtual environment as shown in Figure 8, after the virtual environment verification is applied to the "1 + X" robot equipment, can avoid the first application of intelligent storage algorithm programming, location calculation deviation cause robot collision, damage to the robot and intelligent storage.

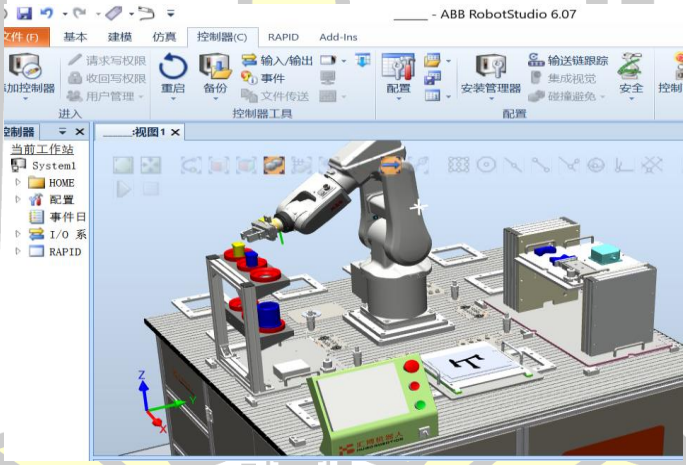


Figure 8: Virtual environment of intelligent storage

3.4 Technical research and analysis

The main object of this study is ABB robot "1+X" system integration equipment, which includes robot body, teaching device, control cabinet, robot end tools, positioner, three-dimensional storage, rotary feed, visual inspection, RFID, loading and unloading conveyor belt and other hardware structures. Combined with robotstdio, PLC, Insight and other software programming technologies, the robot realizes the

whole process control from grasping material unloading, feeding, testing, assembly, unloading and warehousing. It is a small and integrated assembly line production control system.

This research mainly focuses on the primary and intermediate textbooks of "1 + X" Industrial Robot Application Programming (ABB) " compiled by Beijing Sai Yuda Science and Education Co., Ltd. as the technical research reference materials. It mainly studies the relevant technical knowledge of intelligent storage algorithm, visual detection and system comprehensive application in the equipment.

3.4.1 Intelligent storage algorithm

(1) Signal detection and analysis

The equipment provides two lines and three columns with a total of 6 warehouses, The schematic diagram of intelligent storage is shown in Figure 9. Each library is equipped with its own specific photoelectric sensor, namely SEN 1-SEN 6, a total of six photoelectric sensors, used to detect its own library for material. The sensor of each position is connected to the Ethernet I/O module. When the position detects the presence of a material, the sensor will feedback the material signal to the material detection register.

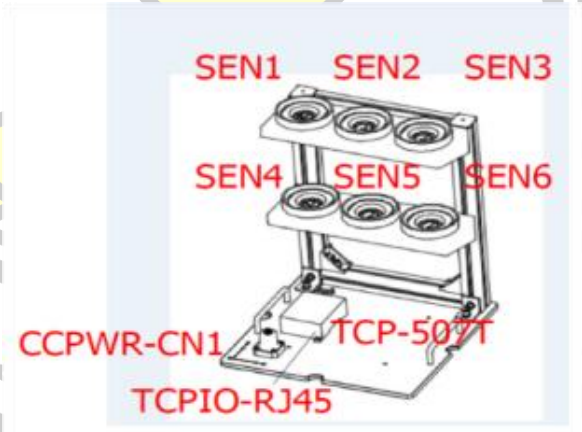


Figure 9: Schematic diagram of intelligent storage

However, because the sensor signal is not a digital input signal, but the communication data, so the industrial robot system cannot directly identify the

position signal, so it is necessary to define the data type of the stored position status data in the robot system, and then use the original data type after conversion. In this regard, in the "1 + X" robot practical training equipment, the "stack" data type has been customized as the data type corresponding to the intelligent warehousing application.

From the primary textbook of "1 + X" Industrial Robot Application Programming (ABB) compiled by Beijing Sai Yuda Science and Education Co., LTD: four types of variables stateout, objectout, statein, and objectin are predefined in stack, representing site material writing, site material information writing, location status feedback, and site material information feedback, respectively. One "statein" array variable is predefined in the "stack", which contains 6 stack1 to stack6 positions with material status information. The description of the variable data types is shown in Table 1.

Table 1: variable data type description

position	Type of variable	variable	data type	variable declaration
1	stack	statein.stack1	byte	0----with no material， 1----with material
2	stack	statein.stack2	byte	0----with no material， 1----with material
3	stack	statein.stack3	byte	0----with no material， 1----with material
4	stack	statein.stack4	byte	0----with no material， 1----with material
5	stack	statein.stack5	byte	0----with no material， 1----with material
6	stack	statein.stack6	byte	0----with no material， 1----with material

When the photoelectric sensors of the 6 library sites detect the material, the library state data is transmitted to the robot through the communication programming between the database and the robot, and the statein array variable end of the robot display device stack data type is displayed as statein= [1,1,1,1,1,1], Use the condition

judgment command IF-ELSEIF to build an intelligent storage material position detection program, which is used to judge the robot picking material position or the finished product storage, so as to avoid picking up space or overlapping collision of storage materials.

(2) Algorithm analysis

The research found that simple and only a small number of warehouse locations can be directly programmed to complete the robot into and out of materials, but in the production line and logistics of large enterprises, the warehouse location is large, mobile robots or forklifts also need to read the warehouse location information, and specify the warehouse storage and storage. Combined with the processing of spatial location data in computer language and C language, similar "bubble algorithm" can be selected for the calculation of two-dimensional spatial storage location selection. As in the following example, the method is as follows:

After comparative analysis, it is found that it is easier to calculate the coordinates of the robot offset motion from 0 count. Therefore, set material No.0123 as line 0, material No.4567 as line 1, and the material location display diagram is shown in Figure 10. The number of rows of item N is pickLine in number and columns are pickColumn. Assuming that the pick is the reference position for picking up material 0. Line and column positions correspond to quotient and residue, respectively, and the offset value in the XY direction is calculated.

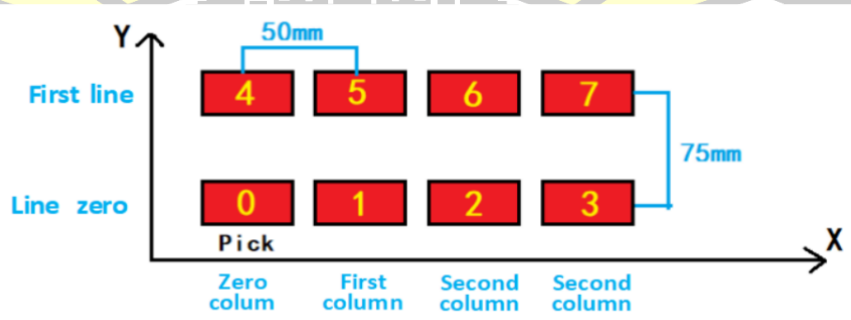


Figure 10: Material location display figure

After experiment and analysis, the summary of position calculation formula is shown in Figure 11.

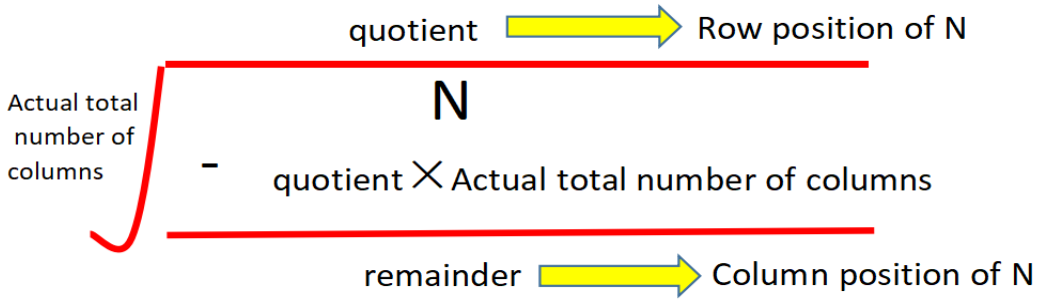


Figure 11: position calculation formula

Four operators are used in the robot writing program, where DIV can obtain the quotient results in division, MOD can obtain the remainder results in division, using DIV to obtain the material N line position, using MOD to obtain the material N column position, the known line position can determine the specific warehouse location of the N material. The calculated formulas obtained are shown in Equations 1 and 2.

N DIV 3= quotient (Equation 1)

N MOD 3= remainder (Equation 2)

For example, in Figure 11, there are 4 columns, material No.5 The location is: 5 DIV 4 = 1; 5 MOD 4 = 1, material No.5 is in line 1, column 1, that is, the coordinate is [1,1], the reference coordinate is position [0,0] of material No.0, because the set line spacing is fixed to 75mm, the column spacing is fixed to 50mm, the final coordinate offset data of material No.5 and material No.0 is [1×75mm, 1×50mm],send the data to the robot, the robot can pick up the specified material according to the location. For the picking and storage of materials in large storage locations, circular instructions can be used to sequentially complete the picking and placing work for each storage location. The assignment data can be overwritten and refreshed to obtain the specified location picking and placing work.

After the example verification and demonstration, the 20 students who

participated in the "1 + X" industrial robot application programming certificate assessment were divided into 5 groups, and then according to the position calculation formula, calculate the coordinate offset data of each material and the relative reference position. Students by using the offset function Offs () in virtual simulation software RobotStudio by simulation verification, reuse the actual "1 + X" robot equipment in the experimental validation, observe the robot movement effect, ignoring the reference position of small deviation, using position calculation formula can make the robot to the position we need. After comparing the experimental effect and the experimental data, the students of 5 groups summarized and obtained the coordinate data of material 0-7 as shown in Table 2.

Table 2: Experimental data of material coordinates No. 0-7

Material Number (N)	Calculate the row location （N DIV 4）	Calculate column positions （N MOD 4）	Get the ranks [line, column]	Whether it conforms to the actual material line position	Coordinate Offset data [Y,X] (mm)	Whether the robot can reach it
0	0 DIV 4=0	0 MOD 4=0	[0,0]	Yes	[0,0]	Yes
1	1 DIV 4=0	1 MOD 4=1	[0,1]	Yes	[0,50]	Yes
2	2 DIV 4=0	2 MOD 4=2	[0,2]	Yes	[0,100]	Yes
3	3 DIV 4=0	3 MOD 4=3	[0,3]	Yes	[0,150]	Yes
4	4 DIV 4=1	4 MOD 4=0	[1,0]	Yes	[75,0]	Yes
5	5 DIV 4=1	5 MOD 4=1	[1,1]	Yes	[75,50]	Yes
6	6 DIV 4=1	6 MOD 4=2	[1,2]	Yes	[75,100]	Yes
7	7 DIV 4=1	7 MOD 4=3	[1,3]	Yes	[75,150]	Yes

The reason for studying warehouse locations is that they are common and essential work processes in many production lines, manufacturing processes, and logistics management. They are often used to store materials or finished products. With the improvement of the intelligence of the manufacturing environment, the manufacturing cycle of products is shortened, and production modes are becoming

diverse. The storage requirements for raw materials, semi-finished products, and finished products are becoming increasingly high. With the rapid development of contemporary science and technology, most of them have adopted mobile robots, palletizing cars or other auxiliary loading and exit machines to replace manual labor, which can greatly improve the work efficiency and save labor costs. Combined with the rapid development needs of the new technology industry and the exploration of vocational education talent training models, the industrial robot industry has increasingly high comprehensive technical requirements for adapting to new high-tech talent positions, and the trend of fully automated unmanned factories is gradually advancing. This makes the task of cultivating talents that meet the needs of robot positions more challenging for vocational colleges.

(3) "1 + X" industrial robot application programming certificate----------Intelligent storage practical training

In the process of the tutor Chaiyong Soemphol's thesis research guidance, I also consulted and learned from Professor Wei Han (industrial robot technology and visual technology competition guidance expert, enterprise project technical guidance consultant) about the "Industrial Robot Technology Application" competition project and "1 + X" robot application programming research related knowledge. And seeking advice from Associate Professor Liao Qiongzhang (an expert in the field of mechatronics integration) and jointly researching the findings of the "mechatronics integration" event in world-class or national vocational colleges in China, the use of robots to complete material outbound and finished product inbound is an essential assessment point. By infiltrating various levels of competitions and certificate assessments, promoting learning through competitions, strengthening technology through the "1+X" certificate mechanism, and integrating the talent needs of enterprise positions, corresponding needs should be implemented in teaching to promote the formation of talent cultivation and reform mechanisms. For example, implementing the "1+X" industrial machine certificate pilot work in teaching requires

the following technical application analysis:

Task point: the appraiser randomly places the materials to be processed in the storage, and requires the robot to detect and remove the materials to be processed according to the signal of the storage location, assemble a complete finished product with other materials, and finally send the finished product to the designated warehouse location for storage.

The sensor is connected to the industrial Ethernet I / O module for position detection and feedback, while the storage module is connected to the main station and the PLC slave station for data transmission, processing and storage, and sends the required signals to the robot. The equipment communication connection is as shown in Figure 12. When the material or the finished product is put into the storage, the robot port can show the feedback of whether the storage material is good or not. The position signal detection situation is shown in Figure 13.

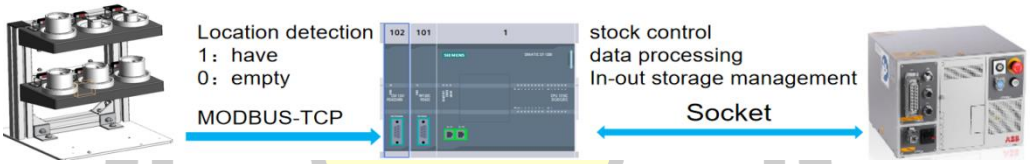


Figure 12: Device communication and connection

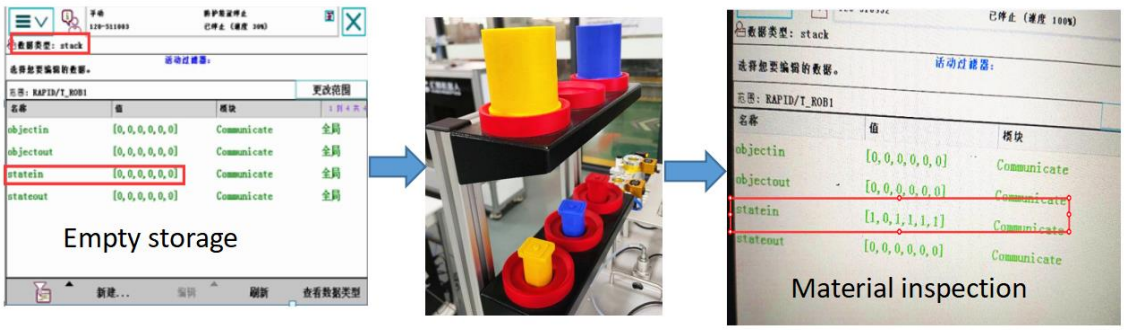


Figure 13: Example diagram of the position signal detection situation

According to the intelligent storage algorithm, combined with the actual storage structure of students as shown in Figure 14, the analysis of "1 + X" industrial robot application programming intermediate program simulation, using the program design

method with parameters, to build the program of the robot to transfer the actual location parameters to Routine1 in the main program main, Routine1 received the actual location parameters. The program design is shown in Figure 15.

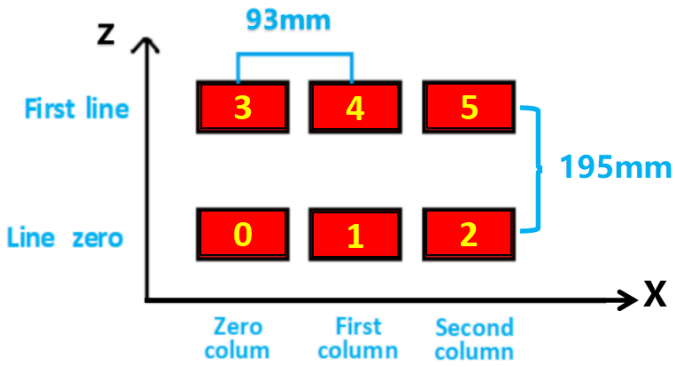


Figure 14: Analysis of the actual storage location structure

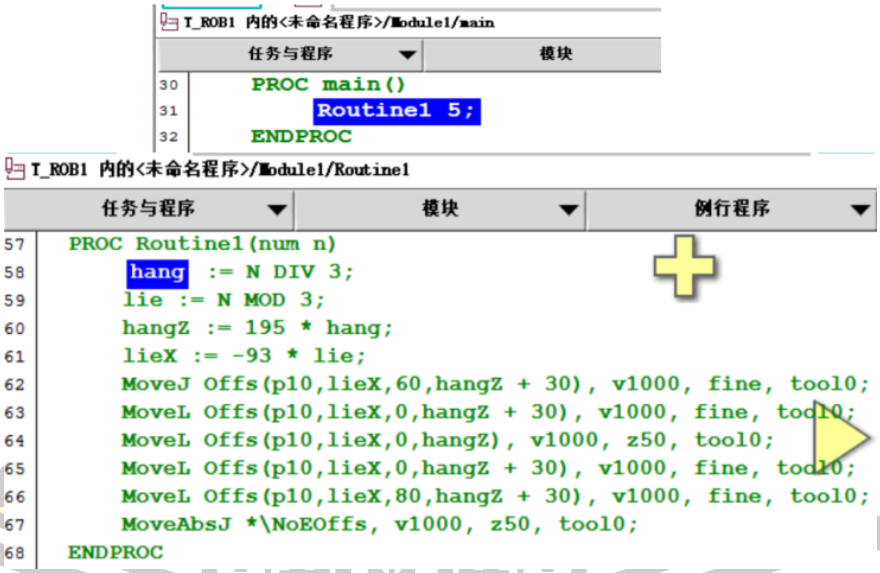


Figure 15: Example of warehousing programming

By using the RobotStudio simulation environment, the robot program operation also found that the robot could accurately reach the specified library location according to the data analysis, and record the data as shown in Table 3.

Table 3: Experimental data of SEN1-SEN6 library bit material coordinates

Material Number (N)	Calculate the row location （N DIV 3）	Calculate column positions （N MOD 3）	Get the ranks	Whether it conforms to the actual material line position	Coordinate Offset data (mm)	Whether the robot can reach it
0	0 DIV 3=0	0 MOD 3=0	[0,0]	Yes	[0,0]	Yes
1	1 DIV 3=0	1 MOD 3=1	[0,1]	Yes	[0,93]	Yes
2	2 DIV 3=0	2 MOD 3=2	[0,2]	Yes	[0,186]	Yes
3	3 DIV 3=1	3 MOD 3=0	[1,0]	Yes	[195,0]	Yes
4	4 DIV 3=1	4 MOD 3=1	[1,1]	Yes	[195,93]	Yes
5	5 DIV 3=1	5 MOD 3=2	[1,2]	Yes	[195,186]	Yes

IF-ELSEIF statement can be used for the surface detection and judgment, and trigger the robot to perform the material storage or storage action. Set that the outbound selection program is named in out, and the warehousing selection program is named in in. Give the actual location parameter to the subroutine Routine1 when the program calls, and the robot can reach the detected position. The programming reference is given as follows.

1) The program design of the material storage location is shown in Figure 16.

```
PROC Routine1(num n)
        hang := N DIV 3;
        lie := N MOD 3;
        hangZ := 195 * hang;
        lieX := -93 * lie;
        MoveJ Offs(p10,lieX,60,hangZ + 30), v1000, z50, tool0;
        MoveL Offs(p10,lieX,0,hangZ + 30), v1000, z50, tool0;
        MoveL Offs(p10,lieX,0,hangZ), v1000, z50, tool0;
        MoveL Offs(p10,lieX,0,hangZ + 30), v1000, z50, tool0;
        MoveL Offs(p10,lieX,80,hangZ + 30), v1000, z50, tool0;
        MoveAbsJ [[0,0,0,0,90,0],[9E+9,9E+9,9E+9,9E+9,9E+9,9E+9]]\NoEOffs, v1000, z50, tool0;
ENDPROC
PROC in() !Storage location selection judgment
    IF statein.stack1=0 THEN
       Routine1 0;
    ELSEIF statein.stack2=0 THEN
       Routine1 1;
    ELSEIF statein.stack3=0 THEN
       Routine1 2;
    ELSEIF statein.stack4=0 THEN
       Routine1 3;
    ELSEIF statein.stack5=0 THEN
      Routine1 4;
    ELSEIF statein.stack6=0 THEN
      Routine1 5;
   ENDIF
ENDPROC
```

Figure 16: Reference example of program design selecting database location

2）The program design of material outlet location selection is shown in Figure 17.

```
85      PROC out() !Selection of outbound location judgment
86          IF statein.stack1=1 THEN
87             Routine1 0;
88          ELSEIF statein.stack2=1 THEN
89             Routine1 1;
90          ELSEIF statein.stack3=1 THEN
91             Routine1 2;
92          ELSEIF statein.stack4=1 THEN
93             Routine1 3;
94          ELSEIF statein.stack5=1 THEN
95            Routine1 4;
96          ELSEIF statein.stack6=1 THEN
97            Routine1 5;
98         ENDIF
99      ENDPROC
100   ENDMODULE
```

Figure 17: Program design reference example for selection of outbound location

The above procedures are mainly aimed at the assessment part of "1 + X" industrial robot application programming certificate, which is a writing method with less storage positions. However, considering the actual enterprise production line, the number of storage is relatively large, and the production efficiency and cost need to be taken into account. After research and experiments with Professor Wei Han, who undertakes enterprise project work, it is found that for the collection and storage of large warehouse materials, the cycle instruction can be used to complete the picking and placing of each warehouse in turn, and the assigned data can be used to refresh the pickup and placement of the specified location.

For large warehouse material pickup and storage, the cycle instruction can be used to complete the picking and release of each warehouse in turn, and the assigned data can be used to refresh the assigned position. In the case of PLC control, touch screen and other devices, in order to reduce the working time of the robot, reduce the cost and improve the work efficiency,

we can also optimize the robot program as shown in Figure 18.

```
PROC Routine1(num n)
        hang := N DIV 3;
        lie := N MOD 3;
        hangZ := 195 * hang;
        lieX := -93 * lie;
        MoveJ Offs(p10,lieX,60,hangZ + 30), v1000, fine, tool0;
        MoveL Offs(p10,lieX,0,hangZ + 30), v1000, fine, tool0;
        MoveL Offs(p10,lieX,0,hangZ), v1000, fine, tool0;
        MoveL Offs(p10,lieX,0,hangZ + 30), v1000, fine, tool0;
        MoveL Offs(p10,lieX,80,hangZ + 30), v1000, fine, tool0;
        MoveAbsJ [[0,0,0,0,90,0],[9E+9,9E+9,9E+9,9E+9,9E+9,9E+9]]\NoEOffs, v1000, z50, tool0;
ENDPROC

PROC Routine2()
    FOR m FROM 1 TO 100 DO
        IF statein.stackm=0 THEN
          Routine1 m;
        ELSEIF statein.stackm=1 THEN
          Routine1 m;
        ENDIF
    ENDFOR
ENDPROC
```

Figure 18: Program optimization and design

Thus, in the teaching, we also need to consider after students learning can combine the actual task, through the theory to practice, by the "1 + X" certificate content to post technical requirements, from the school to the enterprise, by the training equipment to production equipment, improve the industrial robot technology personnel training mode, the post, certificate, course organic integration, training to adapt and suitable for technical skills.

3.4.2 Visual detection technology

In the industrial environment, in view of the modern logistics, machinery and other enterprise products diversification development, modern packaging processing workload, labor cost increase, and to realize automatic production line of different product classification packaging and finished product quality detection, reduce production costs, improve production efficiency, reduce the differences caused by personal fatigue and improper operation, using visual detection technology for automatic classification detection. With the rapid development of digitalization and intelligent technology, robot plus visual system has become a common application mode, which integrates optical, computer, image processing and other fields.

Under the background of the study of "1 + X" certificate system, how to implement intelligent control technology in higher vocational colleges professional

robot visual system technology curriculum and skills certificate of curriculum reform, based on the curriculum reform goal, the machine vision professional skill level certificate requirements into the training objectives and curriculum system of curriculum system, curriculum content, teaching methods, curriculum assessment and curriculum resources, adhere to the professional skill level standards and the principle of curriculum reform, promote the integration of professional skills standards and the depth of the curriculum reform.

（1）Selected equipment

Select Siemens S7-1200 PLC for system logic control and setting communication between camera and robot; ABB industrial robot is used for handling, assembly and other work; The camera of the industrial vision system is Kang camera, which is used to calculate the change value of the workpiece offset. The camera is fixed on the conveyor belt holder, the PC is equipped with In-Sight Explorer vision software, using Ethernet communication protocol, the IP address is set to 192.168.101.50.

Visual need to identify the Workpiece 1 and workpiece 2, which according to the finished product color assembly requirements, the workpiece 1 color (red, yellow, blue) identification, according to the product color and assembly requirements, need to the workpiece 2 color (red, yellow, blue), shape Angle position recognition, robot receives visual recognition data, automatically adjust the workpiece to complete the product assembly task, at the same time will automatically identify data adaptation, sorting out the color does not match the workpiece.

(2) Visual system workflow and technical analysis

Industrial vision system is an image recognition machine for automatic inspection, automation of workpiece processing and assembly, and control and monitoring of production process. The industrial vision system converts the acquired targets into image signals through the image acquisition hardware (camera, lens, light source, etc.), and transmits them to the dedicated image processing system. Study and

learn visual technology knowledge from the primary and intermediate textbooks of "1 + X" Industrial Robot Application Programming (ABB) compiled by Beijing Saiyoda Science and Education Co., LTD.

1） The workflow analysis of visual photography

Conduct the visual hardware installation process as shown in Figure 19 and the software image processing as shown in Figure 20. The hardware part mainly carries out the vision module wiring and the main parameter adjustment, the software part mainly carries out the workpiece image processing, the machine learning and the more accurate data collection.

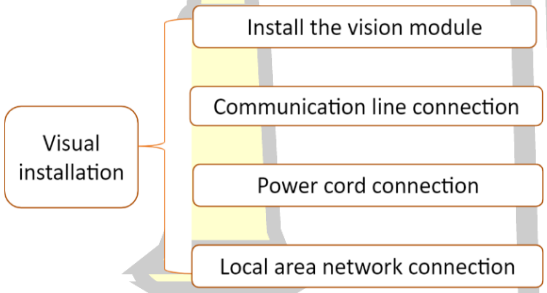


Figure 19: Visual hardware installation process

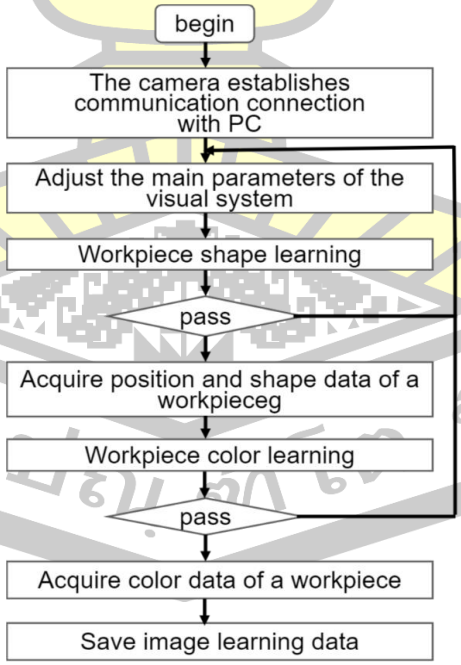


Figure 20: Software image processing process

According to process design, the camera needs to learn three colors, such as the workpiece 1 color data identification, using In-Sight Explorer visual software "color pixel count" color learning training, by adjusting the workpiece 1 camera area location, get the complete workpiece from the circle box area, make the color training interface covers the whole circle box area, finally complete a color training learning. Change the different color workpiece 1, conduct the same method learning and training, and obtain the workpiece color recognition image processing data as shown in Figure 21. In addition, we also need to identify the color of the workpiece 2 in the same way.

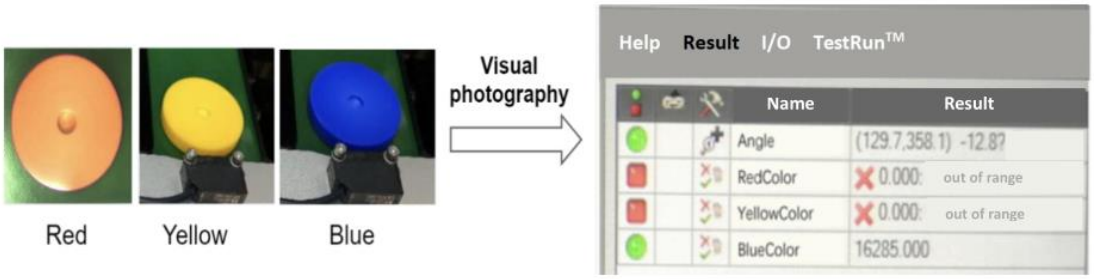


Figure 21: Workpiece color recognition image processing data

2) Data transmission process

Camera ⇨PLC ⇨robot. The PLC acts as a bridge between the camera and the robot. PLC is the main station, camera and robot are the slave station, and data exchange is conducted through establishing Socket connection program. The communication between industrial robot and camera adopts the mode of background task execution, namely, the communication and data interaction between industrial robot and camera are executed in the background task, and the action and signal input and output of industrial robot are executed in the task execution of industrial robot system. The two are run in parallel. In the background tasks, the data obtained by the camera image processing is shared with the industrial robot system tasks through the industrial robot system tasks, the industrial robot is controlled to execute the corresponding procedures according to the data shared by the background tasks. The

communication flow of robot and camera is shown in Figure 22.

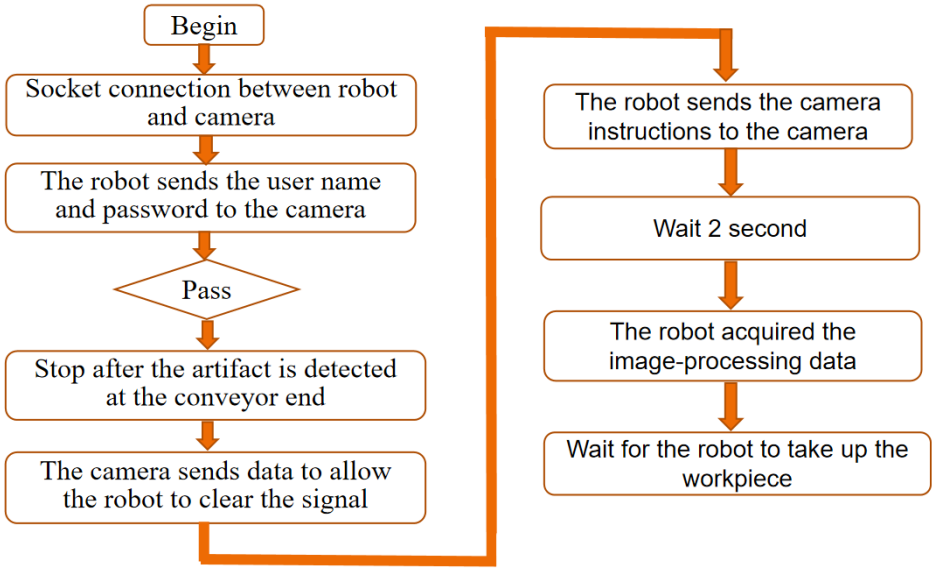


Figure 22: Robotic-camera communication process

(3) Construct the robot and vision correlation program

The robot communicates with the camera through Socket communication related instructions, controls the camera to take pictures and obtains the camera image processing data. The commonly used Socket instructions are shown in Table 4.

Table 4 : Commonly used Socket instructions

serial number	instruction	parameter	function
1	SocketClose Socket	Socket	Close Socket
2	SocketCreate Socket	Socket	Create Socket
3	SocketConnect Socket,Address,Port	Socket	Server socket to be connected
		Address	Remote computer IP address
		Port	Remote computer port
4	SocketSend Socket[\Str]\[\RawData]\[\Data]	Socket	Sockets created and connected
		[\Str]\[\RawData]\[\Data]	Send data to a remote computer
5	SocketReceive Socket[\Str]\[\RawData]\[\Data]	Socket	Sockets created and connected
		[\Str]\[\RawData]\[\Data]	Receiving remote computer data

6	StrPart(Str ChPos Len)	Str	character string data
		ChPos	String start position
		Len	Intercepted string length
7	StrToVal(Str Val)	Str	character string data
		Val	Save a variable whose string is converted into a numeric value.
8	StrLen(Str)	Str	Gets the string data length

1) Robot and camera communication program

Establish a socket connection, where Socket1 represents the socket that has been created and connected, string1 is used to receive and save camera confirmation data, IP="192.168.101.50", port "3000".

"Admin \ 0d \ 0a" means that the robot sends the user name to the camera, "se8 \ 0D \ 0A" means that the robot sends a photo command (password) to the camera, where "\ 0D \ 0A" means the return of 2 characters. A string1 of 1 receiving photo data indicates visual success, and string1 represents visual failure without 1.The robot-camera communication program design is shown in Figure 23.

```
SocketClose Socket1;
SocketCreate Socket1;
SocketConnect Socket1, "192.168.101.50", 3000;
SocketReceive Socket1\Str:=string1;
SocketSend Socket1\Str:="admin\0D\0A";
SocketReceive Socket1\Str:=string1;
SocketSend Socket1\Str:="se8\ 0D\0A";
SocketReceive Socket1\Str:=string1;
```

Figure 23: Robot and camera communication programming

2)Workpiece Type and Data Conversion

During the process of conveying the workpiece, the conveyor belt cannot guarantee that the work piece remains unchanged at the same Angle. When the

workpiece is offset during the conveying process and reaches the terminal detection point of the conveyor belt, it is necessary to take visual photos. The robot will sort the workpiece according to the requirements to obtain the required workpiece 2 for the finished product assembly. However, the shape of the conveying workpiece 2 is relatively special, and the position deviation will cause the assembly bayonet does not correspond to be correctly assembled, as shown in Figure 24. After using the visual system to learn the workpiece 2 angles, the rotation angle of the workpiece 2 is obtained, and the robot adjusts the attitude according to the data receiving feedback from the camera to complete the correct assembly task.

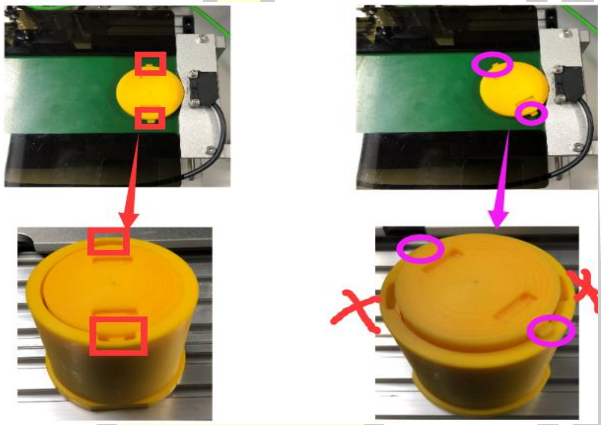


Figure 24: Schematic diagram of assembly of workpiece 2

The robot itself cannot recognize the type, color and position change of the workpiece. It recognizes the features of the workpiece and adjusts the robot pickup workpiece according to the specific value received. The data obtained by the camera is in the form of string, which needs to be converted before the robot can read and use it.

It is worth noting that the whole string length of punctuation marks includes punctuation, return, space and its own space, etc. According to the requirements, it is necessary to intercept the string data representing the workpiece rotation Angle, workpiece type, workpiece color (red, yellow, blue) from the string receiving and saving the camera confirmation data.

Considering the efficiency of data transmission, the numerical value from string data conversion is received in the form of array. When the visual photo is captured and the required string data, the string data is converted into numerical value using StrToVal instruction and stored in the array sj {4}. For example, after identifying the Angle of the workpiece, the Angle data can be directly extracted, and the StrPart instruction can be extracted, and then the data can be intercepted and the data converted. As verified, the program can be designed as shown in Figure 25.

```
SocketSend Socket1\Str:="GVJob.FormatString\0d\0a";
SocketReceive Socket1\Str:=string1;
string2:=StrPart(string1, 7, StrLen(string1)-8);
flag1:=StrToVal(string2, sj{4});
```

Figure 25: Example of string data to numerical data program

3) Students complete the workpiece recognition experiment

Through the study and application analysis of In-Sight Explorer vision software, students can master the basic knowledge of visual detection technology step by step from hardware to software, from process analysis to textbook case imitation, and from theory to practical application. According to the "1+X" industrial robot application programming vocational skills intermediate certificate simulation problem and the research on the visual part of the course teaching, the complete workpiece identification and sorting process is a required test point.

Students combined with the analysis of the analysis and learning of vision, 20 students are divided into five groups, each group cooperation on 10 sets of research simulation of the workpiece assembly requirements after analysis and summary, each student assigned a "1 + X" robot equipment, through the continuous use of visual workpiece photo learning, adjust the workpiece photo Angle, light, image area and model area size and location, and according to Figure 23 and Figure 25 program practice verification.

Each student after many times in the robot teach device data display port for

experimental data recording and analysis, team members share each other and analysis of their own experimental process and data, explore the visual photo control program identification workpiece Angle change, workpiece type and workpiece color can be more practical, more optimized, and identify the accuracy is higher. Students summarize and construct the complete workpiece identification program as shown in Figure 26.

Note: "0 \ 0D \ 0A" indicates photo failure; "1 \ 0D \ 0A" indicates successful photography; the four data behind the "1 \ 0D \ 0A" represents red, yellow, blue, workpiece type; the last data represents the workpiece location angle. Only one piece of information can be identified per photo.

The reference of workpiece data, workpiece Angle, workpiece type and workpiece color obtained by using the program in Figure 26 is shown in Table 5.

```
76    PROC shijue()
77      FOR i FROM 1 TO 2 DO
78        SocketClose Socket1;
79        SocketCreate Socket1;
80        SocketConnect Socket1, "192.168.101.50", 3000;
81        SocketReceive Socket1\Str:=string1;
82        SocketSend Socket1\Str:="admin\0D\0A";
83        SocketReceive Socket1\Str:=string1;
84        SocketSend Socket1\Str:="\0D\0A";
85        SocketReceive Socket1\Str:=string1;
86        SocketSend Socket1\Str:="se8\0D\0A";
87        SocketReceive Socket1\Str:=string1;
88        SocketSend Socket1\Str:="GVjob.FormatString\0d\0a";
89        SocketReceive Socket1\Str:=string1;
90        string2:=StrPart(string1,7,StrLen(string1)-8);
91        flag1:=StrToVal(string2, sj{4});
92        FOR x FROM 1 TO 3 DO
93           string2:=StrPart(string1,3+x,1);
94           flag1:=StrToVal(string2, sj{x});
95        ENDFOR
96      ENDFOR
97    ENDPROC
```

Figure 26: Complete workpiece identification program design

Table 5: Data Analysis Record of Visual Recognition Workpiece Experiment by Students

Data taken from photographs	Photo completion status	Workpiece Angle	The outer loop intercepts valid data	Determine the type of workpiece	The inner loop intercepts valid data	Workpiece color
0\0D\0A00000	fail	###	#	###	#	##
1\0D\0A0000-7.6	success	-7.6 °	0	Workpiece 1	0	fail
1\0D\0A1000-0.0	success	0 °	0	Workpiece 1	1	red
1\0D\0A100119.3	success	19.3 °	1	Workpiece 2	1	red
1\0D\0A0100-3.3	success	-3.3 °	0	Workpiece 1	1	yellow
1\0D\0A0101-21.7	success	-21.7 °	1	Workpiece 2	1	yellow
1\0D\0A0010-15.4	success	-15.4 °	0	Workpiece 1	1	blue
1\0D\0A0011-12.8	success	-12.8 °	1	Workpiece 2	1	blue

With the development of science and technology, for the diversification of product types of modern packaging and processing enterprises, the application of "robot + vision system" is more and more extensive in the production line, and gradually occupies an important position in the future development of intelligent manufacturing industry. Therefore, in vocational colleges and courses of machine vision technology learning course also gradually increased, in addition to the "1 + X" machine vision system application certificate system on visual technology, in the "1 + X" industrial robot application programming certificate system, visual part also occupies an important proportion, in the world-class or national skills competition project also highlights the importance of visual learning.

3.4.3 Comprehensive analysis of "1 + X" robot equipment

The complete production line is not only a single storage, visual technology, but also includes technical knowledge of other disciplines, "1 + X" equipment integrates PLC technology, visual technology, touch screen control, loading and unloading

transportation, displacement machine, storage, robot common typical work (such as glue, palletizing, handling, assembly) and other knowledge. In the "1 + X" certificate assessment training, through the PLC programming software, the establishment of PLC and industrial robot communication, to realize the control of each module of the equipment; Complete materials or finished products through storage location sensor detection; record and query the assembly process of product

process through RFID; Conveying and sorting materials or workpieces through loading and unloading conveyor belts and visual photography; Realize displacement assembly through position control of displacement machine; The whole workpiece assembly requirements are shown in Figure 27, and the whole system workflow is shown in Figure 28.

Figure 27: Assembly requirements for the entire workpiece

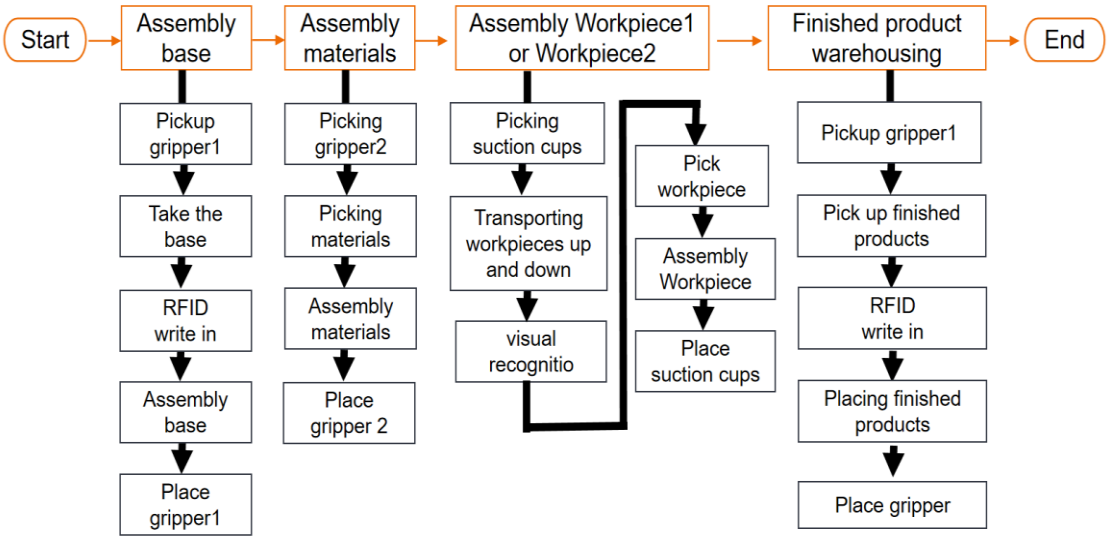
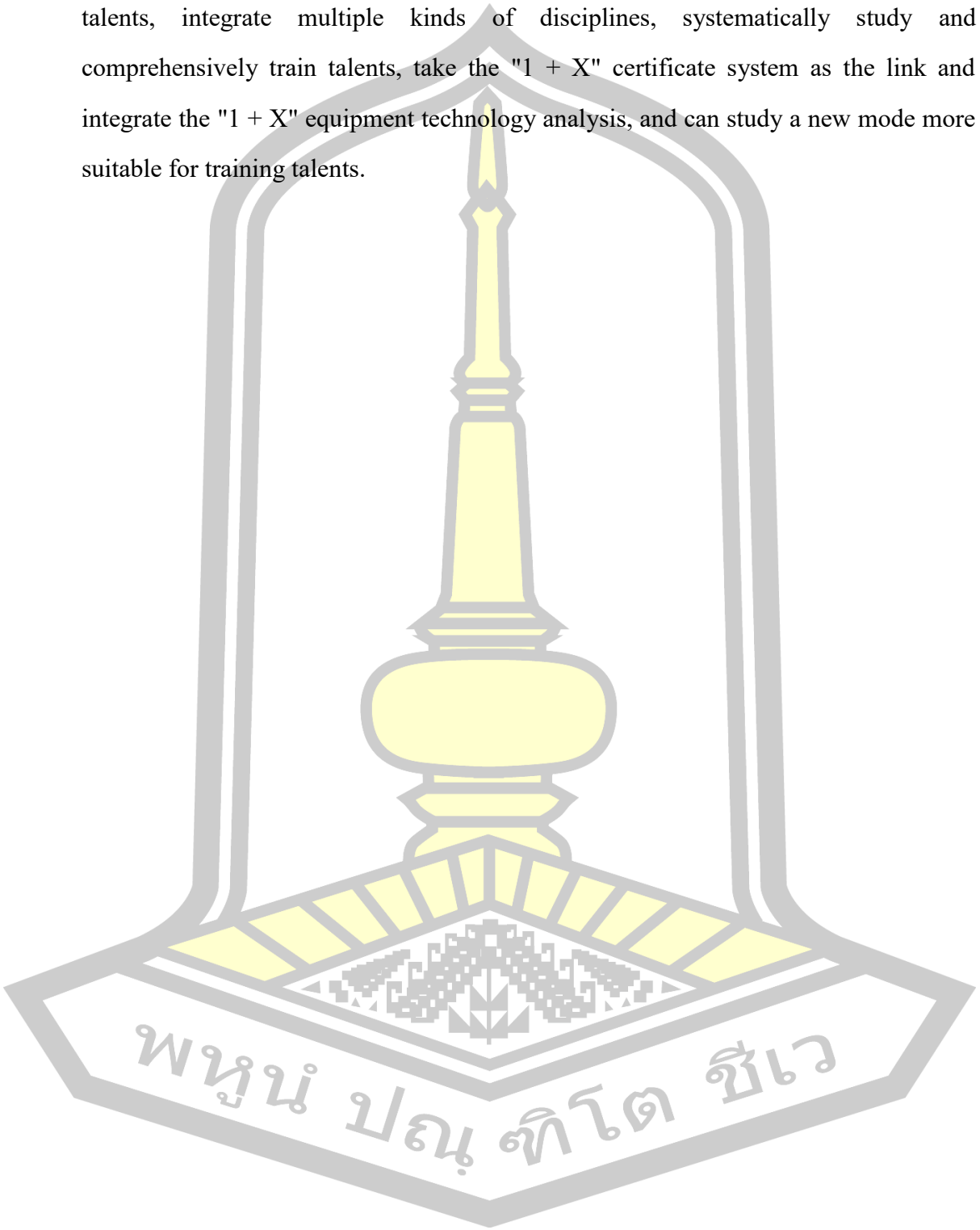


Figure 28: Whole "1+X" Robot Equipment Workflow

It is necessary to deepen the reform of the training mode of compound technical talents, integrate multiple kinds of disciplines, systematically study and comprehensively train talents, take the "1 + X" certificate system as the link and integrate the "1 + X" equipment technology analysis, and can study a new mode more suitable for training talents.



Chapter 4 Results and Discussion

4.1 Reflections of students' learning results

In promoting the comprehensive education of "post class competition certificate", Under the teaching reform mechanism of comprehensively improving the training quality of compound technical skills talents in industrial robot technology majors, Construction of the "1 + X" robot training base, Integration and reconstruction of industrial Robot Programming and Operation of Industrial Robot, Organize students to conduct "1 + X" industrial robot application and programming vocational skill level certificate training and assessment work, Implement the reform plan for the training of industrial robot professionals in the university, Realize the construction of intelligent manufacturing professional group and the 1 + X pilot teaching reform, To realize the organic combination of students' training goals and the professional standards of "X" vocational skills certificate, Students realize the value of personal ability throughout the study, It is mainly reflected in the following aspects.

(1) Obtain the professional skill level certificate

From 2021 to 2022, a total of 120 students have participated in the "1 + X" vocational skill level certificate examination of industrial robot application programming, and 106 students have obtained the certificate, However, when the intermediate certificate examination was opened for the first time in 2020, the pass rate was only about 33%, and the implementation effect of the "1 + X" certificate was not obvious. After the integration of "Post class competition and Certificate" and the reconstruction of "Industrial Robot Programming and Operation" course and the revision of industrial robot technology professionals in 2021, the new talent training mode has been implemented from the primary certificate assessment, and the initial effect of 100% pass rate has been achieved. with a pass rate of 88.3%. Therefore, the second intermediate examination examination was held in 2022, and 20 students

participated in the intermediate examination, among which 18 students passed the examination, with a pass rate of 90%. Compared with the pass rate of the intermediate certificate examination first opened in 2020, the pass rate in 2022 has been greatly improved. The matching of the intermediate certificate in 2020 and 2022 is shown in Figure29.

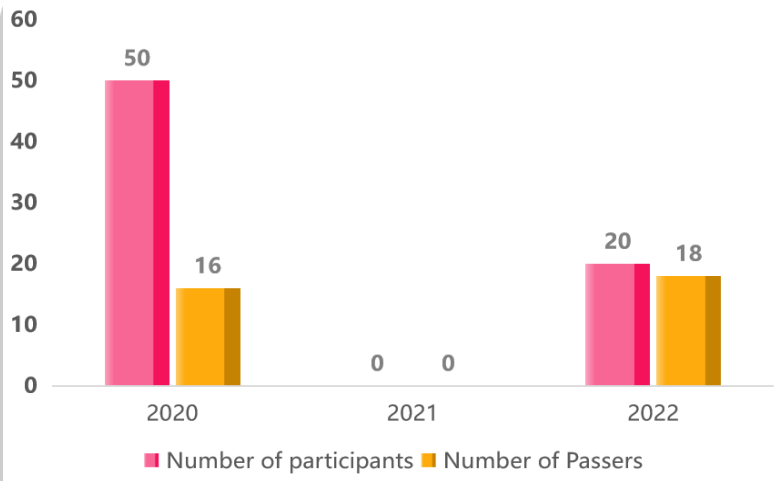


Figure 29: Comparison of intermediate certificates in 2020 and 2022

(2) Improve the comprehensive application capability

In the process of course reconstruction and teaching, the "1 + X" industrial robot application programming vocational skill level standard is integrated into the course and implemented in classroom teaching. From the standard requirements of primary certificate to the standard requirements of intermediate certificate, students can comply with the safe operation specifications, set the parameters of industrial robots, manually operate industrial robots; can skillfully teach industrial robots according to the process requirements; be able to connect and control industrial robots and common peripheral equipment; can write industrial robots and system applications according to the actual requirements; be able to build the corresponding virtual simulation environment according to the actual workstation, and program the typical industrial robot system offline. In the learning process, I gave full play to the team spirit, cooperated together, and made progress together, and completed the "1 + X"

industrial robot application programming professional skill level assessment.

(3) Lay the knowledge foundation of skill competition

Using "questionnaire star" to attend the research of 20 students have employment questionnaire survey, in the "whether participated in industrial robot, mechatronics, visual skills competition and in" 1 + X "industrial robot application programming certificate of learning technical knowledge for you to participate in the skills competition" two questions, the survey results as shown in Figure 30 and Figure 31. From the perspective of the results, participating in the "1 + X" industrial robot course can not only obtain the vocational skill level certificate, but also lay the foundation of theoretical knowledge and technical operation for participating in the skill competition.

Q 1： Have you ever participated in the industrial robot, mechatronics, and visual skills competitions?

Single selection	Total	Proportion
Yes	9	45%
No	11	55%
Headcount	20	

Figure 30: Survey results of whether the students participated in the skills competition

Q 2： Is the technical knowledge learned in the "1 + X" industrial robot application programming certificate assessment helpful to the skills competition you participate in?

Single selection	Total	Proportion
Very helpful	9	45%
Avail	5	25%
Help is very little	1	5%
Didn't in the competition, I don't know	5	25%
Headcount	20	

Figure 31: Whether the "1 + X" industrial robot learning contributes to the results of the competition questionnaire survey

(4) Improve the awareness of career job tasks

In the professional classification of the People's Republic of China (2022 edition) in the public draft, the main task of industrial robot system operator put forward clear requirements, such as: to use the teacher, computer, configuration software tools, the industrial robot, programmable logic controller (such as PLC) equipment and visual, location and other sensors for programming and debugging. The "1 + X" robot equipment contains knowledge and technology that just meet the task requirements of the post. In the process of learning and training, students are guided by the vocational work process, and through project learning, they reserve theoretical knowledge, practical technology, working methods and basic professional norms.

(5) Promote students' employment and career development

A questionnaire survey on "1 + X" industrial robot learning and certificate assessment was conducted to 20 employed students. The results are shown as shown in Figure 32 and Figure 33. According to the results, the students who participated in the certificate examination Seventy-five percent of the students are directly engaged in the work related to their major, and said that learning the "1 + X" industrial robot technology in school can help with their current work, and can promote personal employment and career development.

Q 3：Are you now engaged in industrial robot technology, electromechanical integration technology and other related work?

Single selection	Total	Proportion
Yes	15	75%
No	5	25%
Headcount	20	

Figure 32: Results of whether engaged in professional related work

Q 4：Does the knowledge you have learned in the research help you in your current job?

Single selection	Total	Proportion
Very helpful	8	40%
Avail	9	45%
Help is very little	1	5%
No help at all	2	10%
Headcount	20	

Figure 33: Whether the "1 + X" industrial robot learning is helpful to the results of the work questionnaire survey

4.2 Reflections of research value

In the reform mechanism of "1+X" robot technology application to promote talent training, "1+X" robot equipment is mainly used as the carrier. Integrating the requirements of China's "14th Five Year Plan" robot industry development plan, the Occupational Classification Code of the People's Republic of China Occupational Classification Canon on industrial robot jobs, vocational skills competition, the teaching standards of the school's "Industrial Robot Programming and Operation" course, talent training programs, teachers, school enterprise cooperation, intelligent manufacturing industry chain development and other aspects.

To analyze the "1 + X" robot equipment in warehousing and vision, for example, thinking and rebuild to meet the industrial robot professional and technical personnel training teaching content and teaching mode, combined with jobs, events, certificates and courses, discipline together, from software to hardware, from a single module to the comprehensive application development of students' thinking and application ability.

(1) Recognition and pass rate statistics of "1+X" robot application programming certificate

According to the list of the second batch of pilot institutions under the Institute

of the Ministry of Education in 2019, a total of 3,278 pilot projects under 10 certificates. In this batch, the industrial robot application programming professional skill level certificate pilot institutions has 325, and related to industrial robot "1 + X" certificate pilot and industrial robot operation and operational professional skill level certificate pilot colleges 397, thus, cultivating industrial robot technology talents in the development of vocational colleges education.

"1 + X" industrial robot certificate value is very high, and the implementation of the talent training mode, to promote students and related industrial workers skills, promote high quality employment is of great significance, it also for the industrial robot application skills talent team construction provides innovative solutions, marks the industrial robot in the field of applied skills training began a new chapter.

After field investigation, the official website of Beijing Sai Yuda Science and Education Co., Ltd. and the data published on the official website of vocational colleges, according to incomplete statistics, the number of students who obtained the number of students participating in the "industrial robot application programming certificate of" 1 + X " from 2021 to 2022 is shown in Figure 34.

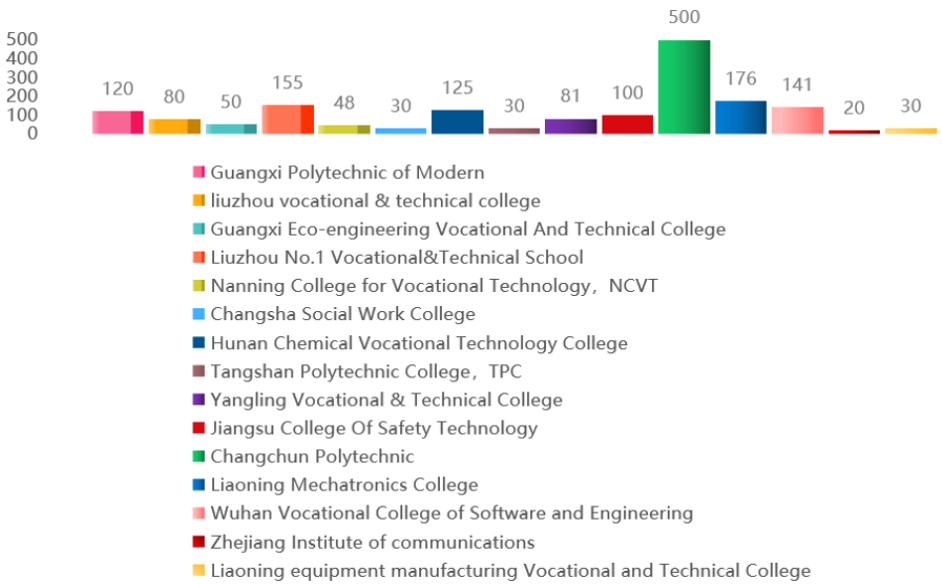


Figure 34: Number of students from 15 vocational colleges participating in certificate examination

Among them, 10 schools announced the number of students and the situation of passing the examination on their official website. After using the formula of "pass rate = number of passes / number of participants", the data of "1 + X" industrial robot application programming pass rate of 10 schools is shown in Figure 35. Combined with the analysis and calculation of Figure 34 and Figure 35, a total of 776 students from these 10 schools participated in the "1 + X" industrial robot application programming vocational skill level certificate examination, among which 651 students passed the examination, with a pass rate of about 83.9%. It can be seen that the schools approved to be the "1 + X" industrial robot application programming are rapidly implementing the "1 + X" certificate system.

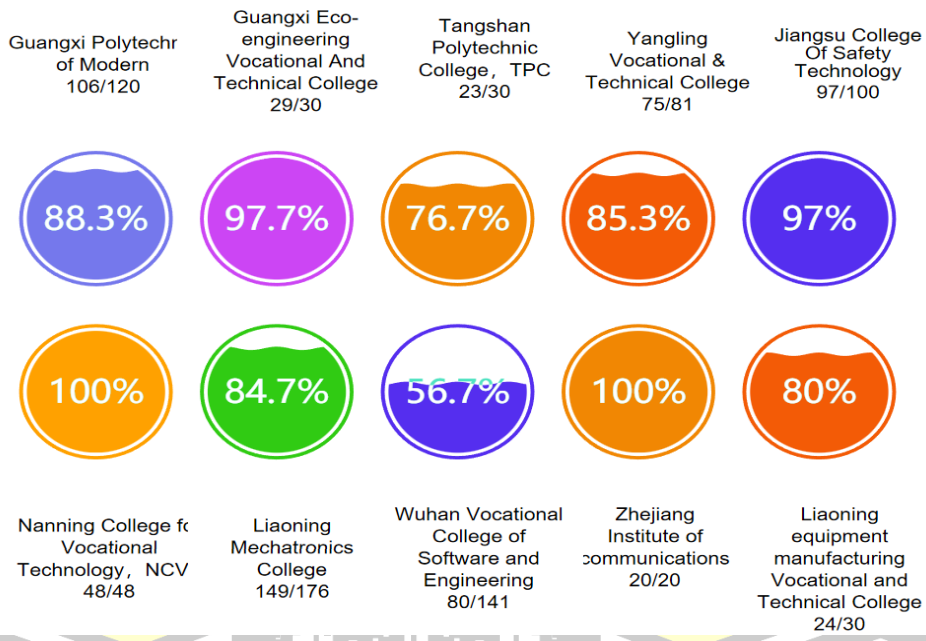


Figure 35: Data Chart of "1+X" Industrial Robot Application Programming Pass Rate in 10 Schools

In summary, the paper analyzes and combines the pilot work of "1 + X" industrial robot application programming certificate in our university, cultivates talents in teaching, carries out the integration of vocational skill level certificate and professional talent training, combines the professional characteristics, integrates the

certificate assessment content into the professional talent training program, and optimizes the talent training program. Focusing on intelligent equipment, Internet of Things and data sources based on industrial robots, cultivate students' robot application related software modules, sensors, vision system, mechanical technology, execution drive and Internet of Things integration technology and other related application capabilities [15]. To promote the characteristic application of "robot +" application ability in the "14th Five-Year robot development plan", and form its own professional teaching talent training mode.

(2) Promote the knowledge integration of skill competition and certificate assessment

Mechatronics technology plays an important role in all fields. The development of this technology can not only improve the quality of products in many industries, but also promote the overall development of the country. At the same time, with the development of mechatronics technology, it has gradually realized the deep integration with other fields, developing towards a more modern and technological trend. In the process of cultivating talents, what can not be ignored is the formation of competitiveness consciousness. In the face of the survival of the fittest in the society, having strong technology, strong ability to resist pressure, a strong sense of competition and strong psychological quality can effectively promote a person's progress.

By participating in the competitions hosted by authoritative institutions, the level of technical skills can be quickly improved, and the importance of promoting learning and teaching through competition can be given feedback. To this, with Liao Qiongzhang associate professor research "electromechanical integration" countries equipment also found, the equipment also exists warehouse, vision, PLC and other related technology, we can be "1 + X" robot equipment teaching knowledge transfer to skills competition, comparative analysis, to systematic detection and cultivate the students' comprehensive application ability.

Take the "mechatronics" competition as an example, the equipment used is a complete small production line, composed of particle feeding, cover, detection and sorting, industrial robot handling, intelligent storage, a total of five single modules. The equipment integrates industrial robot technology, PLC technology, machine vision technology, communication application technology, sensor technology and other knowledge, and can realize the whole process of intelligent sorting and assembly, automatic packaging and quality testing, intelligent storage. After learning the knowledge of "1 + X" industrial robots, students can quickly analyze and apply industrial robots, vision, sensors and intelligent storage technology to solve basic problems. In addition, the "Robot System Integration Application Technology" competition also includes many "1 + X" industrial robot application programming technology.

Competition promotes learning and competition promotes teaching research. In the training and teaching of certificate assessment, the competition guidance mode is adopted and the competition assessment mechanism is set up to effectively promote the progress of students. In the skills competition, students can give full play to what they have learned, complete the tasks of the competition site, and get excellent results.

Chapter 5 Conclusions

5.1 Key Findings

(1) Expand the promotion degree of the "1 + X" certificate system

The study found that in competition of 2022 "1 + X" certificate system pilot work advance will and 2021 certificate work summary meeting, Wang Zhiqiang, general manager of Beijing Sai Yuda Company, pointed out that in 2021 industrial robot application programming professional grade certificate pilot colleges and universities covering 30 provinces and municipalities, autonomous regions and municipalities directly under the central government 582 colleges and universities, pilot work in colleges and universities and enterprises.

In 2022, the company will continue to promote documentary evidence financing landing, assist colleges and universities to carry out curriculum and skills transformation, the key textbook revision and question library supplement work, make full use of the existing resources, reduce the pilot institutions financial investment, vigorously promote diversified assessment, play to education as a platform enterprise service advantage, continue to promote certificate connotation construction, efforts to expand the certificate of social recognition, power pilot colleges and universities to carry out the characteristic construction, improve education teaching quality. It can be seen that the promotion of the "1 + X" industrial robot certificate system has achieved obvious results.

(2) Expansion of the application of extension technology

In the process of teaching and training, it is found that the intelligent storage algorithm is also applicable to the robot palletizing work. In overlapping palletizing workstations and crisscross palletizing workstations, students can also use the intelligent palletizing algorithm, and the number and application of programs are higher. The students who participated in the skills competition said that the "robot

programming", intelligent storage, visual detection and other technologies in the "1 + X" industrial robot application programming professional skills intermediate certificate are suitable for the "mechatronics" competition, which can make them quickly adapt to the use of equipment.

(3) Optimize the talent training mode

Since the 13th Five-Year Plan, through continuous innovation and deepening reform, China's robot industry has maintained a good momentum of development, and the industrial scale has grown rapidly. According to 15 departments about printing "" difference "robot industry development plan", according to the notice file: in a new round of technological revolution and industrial revolution, robot as an important carrier of emerging technology and the key equipment of modern industry, leading industry digital development, intelligent upgrade, constantly breeding new industry new mode new forms. The State Council issued the Implementation Plan for National Vocational Education Reform and the Pilot Plan for Implementing the System of "Academic Certificate + Several Vocational Skill Level Certificate" in Colleges and universities to provide a strong opportunity for the reform of industrial robot technology personnel training in vocational colleges, which is an important basis for promoting the formation of the reform mechanism of talent training.

5.2 Limited to future work

In the process of research, it is found that although the school has built a standard "1 + X" industrial robot teaching and training base, robot brand learning is mostly limited to ABB machine personnel, and robot brand learning is still less, which is not conducive to the employment development of students. Moreover, the degree of integration between the current course and the intermediate certificate assessment is not high enough, the construction of the intermediate certificate resources is not perfect, and there is a lack of simulation model compared with the actual equipment. At the same time, the number of applicants for intermediate certificate assessment is

small, and the coverage has not reached 100%. In the long run, it is not conducive to the development of high quantity and high quality of talent training.

In view of the above problems, considering the current direction of education reform of Chinese vocational colleges and the actual situation of our school, in the future, add basic learning of other brands such as FANUC, Kuka and Turing robots; around the intermediate certificate assessment content, integrate teaching resources, add video cases and simulation effects, and build course resources in the "Superstar Learning" platform to facilitate students to study anytime and anywhere. In 2023, it will increase the number of applications and improve the coverage of intermediate certificate assessment. At the same time, the whole student training organization will be established to enhance students' professional knowledge and comprehensive application ability, so that students can better serve the modern manufacturing industry.

APPENDIX

A questionnaire survey of 20 graduates on the study and certificate of "1 + X" industrial robot application programming certificate assessment

1. Name:_____

2. Graduation major:_____

3. Have you obtained the "1 + X"?

☐Yes ☐No

4. Have you ever participated in the industrial robot, mechatronics, and visual skills competitions?

☐Yes ☐No

5. Is the technical knowledge learned in the "1 + X" industrial robot application programming certificate assessment helpful to the skills competition you participate in?

☐Very helpful ☐Avail

☐Help is very little ☐Didn't in the competition, I don't know

6. What is your evaluation on the learning process of conducting the "1 + X" industrial robot application programming certificate examination in the school?

☐Very wonderful ☐Very good ☐Good ☐General ☐No good

7. Are you now engaged in industrial robot technology, electromechanical integration technology and other related work?

☐Yes ☐No

8. Does the knowledge you have learned in the research help you in your current job?

☐Very helpful ☐Avail ☐Help is very little ☐No help at all

9. What do you think is the more difficult knowledge? (multiple choice)

☐PLC programming ☐Visual inspection

☐Storage selection ☐Robot programming

☐Program optimization ☐Automatic joint adjustment

10. Do you think it is necessary to continue to carry out the "1 + X" industrial robot application programming professional skill level certificate assessment in the future?

☐It is very necessary ☐It doesn't matter

☐Unnecessary ☐I don't know

11. Do you have a plan to continue obtaining a higher professional skill level certificate?

☐Always ready ☐It's still in plan

☐No plan yet ☐Don't plan

12. What do you have better suggestions for the school's "1 + X" industrial robot technology application research?

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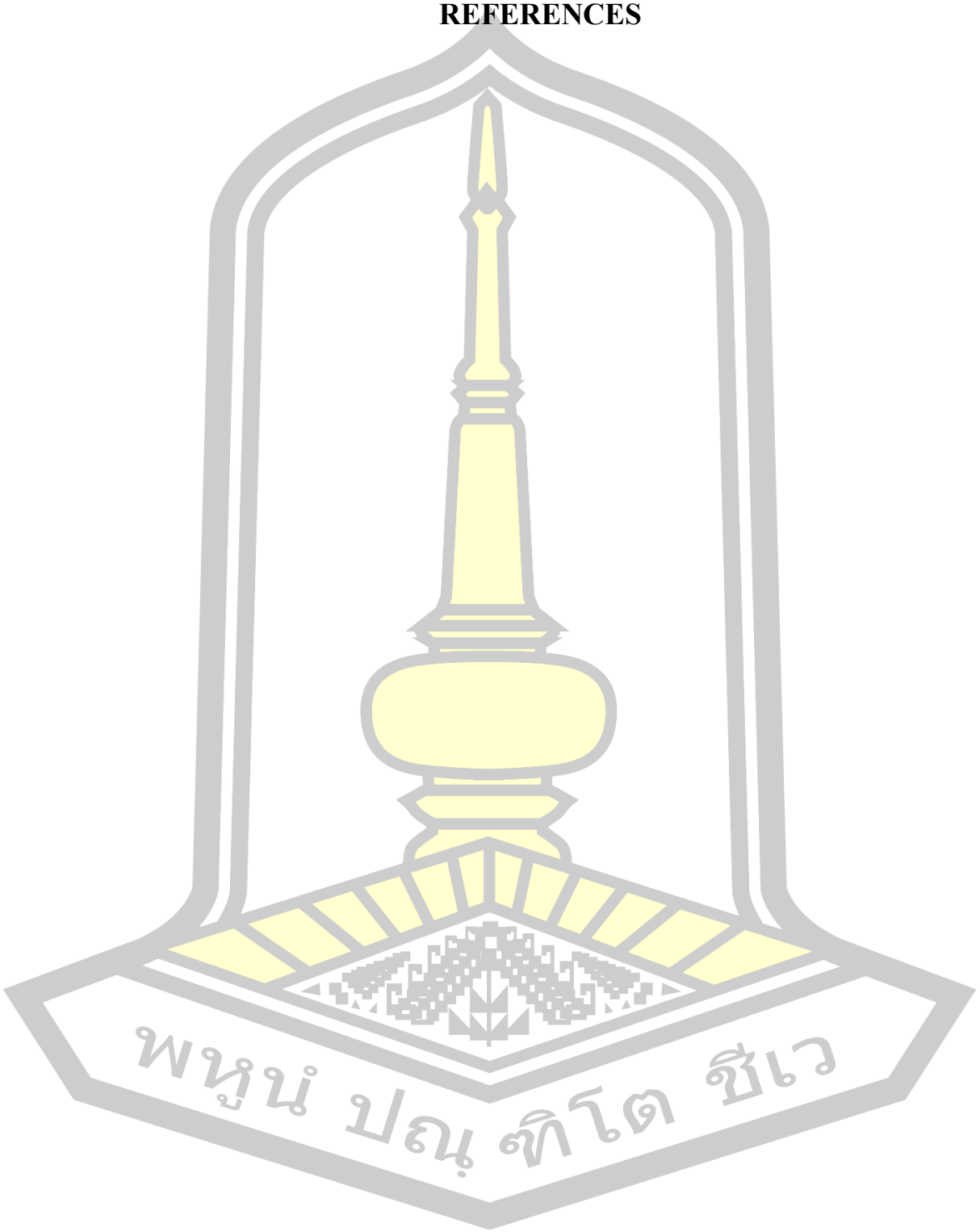

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