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Construction of Curriculum Standards for Machine Vision Technology and Applications Integrating "Post -Course-Competition- Certificate"

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Abstract

Machine vision technology is a key development branch of the intelligent manufacturing industry and an important manifestation of the deep integration of informatization and industrialization. Vigorously developing machine vision is of great significance in accelerating the transformation and upgrading of the manufacturing industry, improving production efficiency, product quality, and realizing the intelligence of the manufacturing process. This article focuses on the reform of curriculum standards to promote the transformation of educational models. Starting from the demand for composite talents in technical positions, typical work projects are used as carriers to jointly build a modular and progressive curriculum system with industry enterprises; Integrating teaching content with the goal of industry certification and skill competition abilities and literacy requirements, and completing the construction of the "Machine Vision Technology and Applications" curriculum standard that integrates "job-course-competition-certificate" integration.

Keywords

Machine vision; Curriculum standards; Post-Course-Competition-Certificate.

1. Introduction

The course 'Machine Vision Technology and Applications' is an important professional expansion course for the electrical automation technology major, serving the equipment manufacturing industry and the electrical automation industry. It is aimed at the position of a technical engineer for the application and development of machine vision technology, cultivating professional abilities in machine vision technology design, development and debugging, thinking methods for analyzing and solving practical problems, patriotic and professional values, and a spirit of striving for excellence as a craftsman. This course supports the cultivation of knowledge and skills related to automation production line technology in the training plan of this major. This course is organically connected with other course modules in the training plan of this major. Based on previous courses such as circuits, programming, and sensor technology, this course focuses on the application of knowledge and technology in digital circuits, C language programming, sensor applications, and other aspects. This course serves subsequent courses such as industrial robot technology, automated production line technology, and industrial vision system operation and maintenance 1+X certification, We will focus on providing technical support for intelligent detection and control.Changing the teaching venues

2. Design ideas

Teaching content requirements. 1) Knowledge and skill requirements. According to the typical work scenarios of machine vision technology engineers, the teaching content is divided into six

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major competency modules: machine vision cognition, machine vision image acquisition, machine vision detection, machine vision measurement, machine vision recognition, and machine vision guidance. Based on each competency module, relevant knowledge and skill points are sorted out to form the teaching content of this course. Integrate knowledge and skills related to machine vision technology into skill competitions and skill level certificates in the application of industrial vision systems. 2) Teaching task design. By transforming typical application cases and scenarios of machine vision technology in production into teaching, designing several teaching tasks for each ability module, integrating knowledge and skill points into teaching tasks, students can master relevant knowledge and skills in the process of completing teaching tasks, and understand the practical application needs of machine vision technology in production. The specific teaching tasks can be found in the teaching design document of this course. Different teachers can design the course according to the actual learning situation.

Teaching method requirements. 1) Benchmarking the work process of vocational positions, implementing project-based teaching methods, adopting action oriented, task driven, combination of theory and practice, and integration of learning and practice to explore relevant teaching methods, with a focus on training students' ability to analyze and discover problems, as well as methods for diagnosing and debugging circuit and program faults; 2) Utilize high-quality digital resources such as animations, videos, and virtual simulations to assist teaching, reduce learning difficulty, improve learning efficiency, and utilize online learning platforms to assist teaching.

3. Course objectives

3.1. Overall Objectives

This course is one of the core courses of the Electrical Automation Technology major, with the overall goal of cultivating students' basic theoretical analysis ability, practical operation ability, and ability to solve practical engineering problems.

3.2. Specific Objectives

Capability objectives

(1) Familiar with the principles of machine vision, including the composition of machine vision systems and typical application scenarios, selection knowledge of light sources, cameras, lenses, etc., laying the foundation for future selection work in industries such as automation, industrial robots, and intelligent manufacturing.

(2) Accurately identify and proficiently analyze and process image features of the tested objects in various typical industries, laying the foundation for future work in visual image processing, programming and debugging.

(3) Capable of script writing and communication management for machine vision, and able to communicate data processed by vision with programmable controllers/robots, laying the foundation for future integrated debugging work in industries such as automation, industrial robotics, and intelligent manufacturing.

(4) Capable of analyzing, extracting, and logically processing image features based on the workpiece to be tested, and possessing script writing and communication data processing capabilities, laying the foundation for future work as an applied visual engineer.

Knowledge objectives

(1) Master the basic principles of machine vision.

(2) Master the calculation methods between light sources, lighting effects, working distance, focal length, and field of view.

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(3) Master the selection of cameras and lenses.
(4) Master the usage of different cameras.
(5) Master image feature analysis and image processing.
(6) Master image recognition, visual calibration, and shape detection.
(7) Familiar with logical operations, communication management, and visual script writing.
Quality objectives
(1) Independent problem-solving ability and innovative awareness;
(2) The ability to learn independently;
(3) Team collaboration and communication skills.
(4) Ability to analyze image features.
(5) A work style of innovation and dedication;

4. Course content and requirements

The teaching project focuses on technical application and operation, closely linking with actual production needs. Highlight the typical and real applications of machine vision technology in the digital upgrading of industries such as electrical automation and equipment manufacturing. Integration of job courses, competitions, and certificates. Integrate the relevant vocational skill level certificates and knowledge and skill points of vocational skill competitions into the curriculum teaching module, effectively supporting students' vocational skill development.

Comparison Table of "Post-Course-Competition-Certificates"

Job Capability Module	Vocational Skills Competition knowledge points and skill points	Vocational Skill Level Certificate knowledge points and skill points
Module 1 Machine Vision Cognition	《Machine Vision System Application Competition》 Selection, installation, and wiring of cameras and lenses Light source selection, wiring, and software control	《Operation and Maintenance of Industrial Visual System》 1.1 Light source selection 1.2 Camera Selection and Settings 1.3 Lens Selection and Settings
Module 2 Development of Machine Vision Image Acquisition Application	《Machine Vision System Application Competition》 The comprehensive detection application covers the comprehensive programming of recognition, positioning, measurement, and detection functions in machine vision applications. Based on specific comprehensive detection application tasks, select functions that match specific competition tasks for combined programming.	1.4 Able to adjust the installation height and angle of the light source according to the working scene and on-site conditions, improving the imaging effect 1.5 Able to correctly set camera shutter, exposure time, frame rate, gain and other parameters based on imaging effect
Module 3 Development of Machine Vision Inspection Application	《Machine Vision System Application Competition》 The comprehensive detection application covers the comprehensive programming of recognition, positioning, measurement, and detection functions in machine vision applications. Based on specific comprehensive detection application tasks, select functions that match specific competition tasks for combined programming.	2.1 Product Target Positioning 2.1.1 Able to use template matching tools to achieve target localization according to detection requirements 2.1.2 Able to use spot analysis tools to achieve target localization according to detection requirements 2.1.3 Able to use grayscale histogram tools to achieve target localization according to detection requirements
Module 4	《Machine Vision System Application	2.2 Image Measurement and Analysis

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Development of Machine Vision Measurement Applications	Competition》 The comprehensive detection application covers the comprehensive programming of recognition, positioning, measurement, and detection functions in machine vision applications. Based on specific comprehensive detection application tasks, select functions that match specific competition tasks for combined programming.	2.2.1 Able to select appropriate measuring tools and accurately measure the length of objects based on detection accuracy requirements 2.2.2 Able to select appropriate measuring tools according to the requirements of detection accuracy and accurately measure the geometric dimensions of circular objects 2.2.3 Able to correctly use result analysis tools to analyze image measurement results 2.2.4 Be able to use data analysis tools correctly to judge image measurement results
Module 5 Development of Machine Vision Recognition Application	《Machine Vision System Application Competition》 The comprehensive detection application covers the comprehensive programming of recognition, positioning, measurement, and detection functions in machine vision applications. Based on specific comprehensive detection application tasks, select functions that match specific competition tasks for combined programming.	2.3 Barcode and Character Reading 2.3.1 Able to correctly read industrial barcodes according to testing requirements 2.3.2 Able to correctly read QR codes according to detection requirements 2.3.3 Able to achieve character verification through OCV tools according to detection requirements 2.3.4 Ability to read characters through OCR tools according to detection requirements
Module 6 Development of Machine Vision Guided Applications	《Machine Vision System Application Competition》 The comprehensive detection application covers the comprehensive programming of recognition, positioning, measurement, and detection functions in machine vision applications. Based on specific comprehensive detection application tasks, select functions that match specific competition tasks for combined programming.	2.4 Product Target Positioning 2.4.1 Able to use template matching tools to achieve target localization according to detection requirements 2.4.2 Able to use spot analysis tools to achieve target localization according to detection requirements 2.1.3 Able to use grayscale histogram tools to achieve target localization according to detection requirements

5. Suggestions for teaching assessment and evaluation

The course assessment should highlight the evaluation of process, development, and value-added. Emphasize the application of knowledge, skill operation, value shaping, quality improvement, and the ability to analyze and solve practical problems.

(1) Highlight the evaluation of process modules. Combining classroom questioning, practical operation, and other process module assessments, strengthen the assessment of practical teaching links, and pay attention to daily score collection.

(2) Strengthen the assessment of ideological and political literacy. Before the design class, students should report their course experiences and ideological and political cases; After class, output summary documents, ideological and political texts, etc. for grading.

(3) Strengthen the evaluation of homework after class. Design assignments with different difficulty levels, fully unleash students' initiative and creativity, and focus on assessing their comprehensive professional abilities and levels.

(4) Strengthen the assessment of team cooperation. Design a team cooperation evaluation system during class to enhance students' mutual assistance and teamwork abilities within the group.

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It is recommended to increase the proportion of regular grades in the overall evaluation score during specific implementation. The usual grades are based on students' attendance, learning attitude, course project completion, and skill testing project completion.

This course uses a combination of regular grades (homework+attendance+classroom performance), skill assessment, and comprehensive assessment to assess students. The total score of the course=usual score (30%)+skill assessment (30%)+final teaching score (40%), and the score ratio can be slightly adjusted by teachers according to the specific situation of students.

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