Application of Computer Visual Recognition in Industrial Automation Assembly Production Line

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Abstract. Computer vision recognition technology refers to the technology of simulating human vision system with computer to realize the functions of object recognition, shape orientation confirmation, motion judgment and so on, in order to adapt, understand the external environment and control their own motion. The present situation of industrial automation in China is that the industries covered by full automation are relatively limited, mainly concentrated in the high value-added industries represented by automobiles, and most industries choose simple automation according to the tradeoff between automation effect and cost. In the course of industrial automation, the corresponding control technology and the most representative programmable controller, industrial computer and intelligent instrument device are developed according to the main characteristics of industrial field, among which computer vision recognition technology is more and more widely used in industrial automation.

Keywords: Automated Production Line, Production Cycle, Computer Vision, Cycle

1. Introduction
Computer vision refers to the technology of simulating human vision system with computer to realize the functions of object recognition, shape orientation confirmation, motion judgment and so on, in order to adapt, understand the external environment and control their own motion. Automatic production line refers to the route composed of such production activities as product manufacturing, transportation, assembly, testing and so on. The main form is to set the single piece time of the working procedure to make it equal or multiple with the beat [1].

In short, computer vision is the science of how to make machines "see" and the extension of human vision on machines. Computer vision integrates optical, mechanical, electronic, computer hardware and software technology, involving computer, image processing, pattern recognition, artificial intelligence, signal processing, optical, mechanical and electrical integration and other fields. With the help of deep learning algorithm, the performance of computer vision technology has made an important breakthrough, which has become one of the basic application technologies of artificial intelligence, and is a necessary means to realize automation and intelligence. In the automatic assembly line, the automatic assembly line is automatically controlled by a computer [1]. It can automatically collect, process and feedback all kinds of information needed for processing and transportation process...
summary, and carry out hierarchical control over processing units and transmission equipment through industrial computers or other control devices. The automatic assembly line integrates high rigidity, high speed and high efficiency. It improves the production efficiency, reduces the production cost, and effectively improves the precision of production and processing, which can make users obtain better economic benefits. Computer vision technology is based on image processing, machine vision and other technologies, but there are different three. Image processing is a technique for image processing based on the basic features of digital images.

2. Technical system of computer vision

The key technology of computer vision can be divided into image processing technology, image feature extraction technology and image recognition and judgment technology according to image processing flow.

Image processing technology is based on the basic features of digital image processing technology. Image processing generally includes image preprocessing and image segmentation: image preprocessing methods include smooth denoising, standardized registration, missing value / outliers processing, etc. Image segmentation is to separate the target from the background. The methods include grayscale segmentation, expert experience segmentation, statistical distribution segmentation and so on. The purpose of image processing is to remove irrelevant information and extract the concerned target from the background. The function of image processing is to accelerate the training process and increase the stability of the model, so as to improve the recognition accuracy. The key of image processing technology lies in the establishment, maintenance and updating of background model in dynamic complex scenes [2]. When the background changes dynamically or is blocked, the difficulty of detection will be greatly increased. Image feature extraction is a technique to extract a set of basic elements or values from images to describe the original image. Image semantic segmentation is one of the core technologies of computer vision, that is, the whole image is divided into independent pixel groups, and then marked and classified. Image semantic segmentation understands the role of each pixel in the image at the semantic level. Unlike classification, image semantic segmentation requires model prediction of dense pixels. Among them, one of the most commonly used original methods is to classify blocks by sliding windows, and to classify each pixel separately by using the image blocks around each pixel, but its computational efficiency is very low because the common features between overlapping blocks can not be shared. At present, image recognition and judgment technology is mainly based on depth learning algorithm, which is used to simulate the complex relationship between data by abstracting data through a series of multi-layer nonlinear transformations. At present, the main deep learning architecture in the field of computer vision is AlexNet, VGGNet, GoogleNet, ResNet, ResNeXt, RCNN, YOLO, SqueezeNet, SegNet, GAN. Image recognition and judgment technology can be subdivided into biometric recognition technology, optical character recognition technology, object and scene recognition technology and video object extraction and analysis technology.

3. The auxiliary role of industrial robot in computer vision technology

3.1. Brief description of industrial robots

Industrial robots are mainly used in arc welding, chemical industry, welding, assembly, logistics handling, cutting, spraying, palletizing and other non-simple and repetitive operations, especially the automobile manufacturing industry needs large robots and can bear weight. Nowadays, flexible and small robots are everywhere in the 3 C electronics industry, improving the accuracy of assembly and processing.

The mechanical body and the controller constitute the industrial robot system. The controller is similar to the human brain, sending instructions to the robot actuator for the action required by the operator to allow the mechanical parts to perform the operation [3]. With the rapid development of computer technology, the controller part of robot is a high-performance computer. The application
technology of industrial robot refers to the application technology developed on the basis of the existing industrial robot. Its main purpose is to enhance the perceptual adaptability of industrial robot, reduce the difficulty of user use, shorten the teaching and programming time, improve the motion accuracy of industrial robot and broaden its application range. The control algorithm block diagram of industrial robots is shown in figure 1:

![Figure 1. The control algorithm block diagram of industrial robots.](image)

3.2. Computer programming of industrial robots

The experimental robot is an open structure, which is especially suitable for flexible application. It can be installed on the wall, installed upside down or mounted on the wall at any angle, and can communicate widely with the external system.

There are two main programming methods of industrial robot: off-line programming and on-line programming, in which off-line programming is based on workpiece digital module to generate robot motion trajectory and control program, which has the advantages of high programming efficiency. Besides the special offline programming software provided by the manufacturers of industrial robots, there are many common third-party offline simulation and programming software (such as RobCAD, Delmia Robotwork, Workspace) and some open source software. But its practicability depends on two prerequisites: one is to have a three-dimensional digital model of the workpiece, the other is the absolute positioning accuracy of the robot and the installation accuracy of the workpiece. The steps of computer programming are as follows: 1. Position unit debugging: a. adjust the level of the machine; b. put the shuttleplate on the position unit. 2. robot coordinate system calibration: a. tool coordinate system calibration: install a needle tip on the TRAY disk and on the center of the robot flange. The tool coordinate system value of the tip of the robot flange is obtained. b. workpiece coordinate system calibration: select three calibration holes on the TRAY disk and install three tips [4]. By using the tip of the robot flange, the tip of the TRAY plate is aligned with four attitudes, and the workpiece coordinate system is established in the tray plane by three-point method. 3. sensor calibration: check the input and output signals on the display screen and set the vacuum gauge pressure value. 4. first fine adjustment a. assembly point: the camera hits the real time, the fixture material moves to the assembly point, adjusts the fixture, causes the workpiece lower surface and the Housing surface to achieve the installation precision in the XYZ three directions. 5. the second fine adjustment a. the robot runs to the assembly point, the camera guides the installation, checks the alignment accuracy. The error of each relative target value is mm. ±0.03.
Table 1. XYZ related data.

|   | X   | Y   | Z   |   |
|---|-----|-----|-----|---|
|   | 12.345 | 13.555 | 6.225 |   |
|   | 11.645 | 11.347 | 5.345 |   |
|   | 17.225 | 15.745 | 7.235 |   |
|   | 18.345 | 8.365  | 4.675 |   |

In this system, the industrial robot body is equipped with all kinds of sensors, which is the actuator of assembly action, and realizes the assembly alignment of the workpiece under camera guidance until the error is within the allowable range [5]. Industrial robots usually have high repeated positioning accuracy. In order to improve the smoothness and motion rate of the robot, the arc transition is adopted at the right angle, and the motion design path is shown in figure 2 below.

Figure 2. Path diagram of robot motion design.

4. Summary
The research of computer vision began in the late 1950s, and the recognition and analysis of two-dimensional images has always been the focus of research.

The main content of computer vision research is to identify and express the shape and position of objects, to restore the spatial structure of objects and to analyze their motion. In more than 20 years of research and development, computer vision has made outstanding efforts and contributions in these two aspects, not only has the ability to perceive three-dimensional environmental information, but also can store, identify and understand the perceived information [6]. Therefore, it is more and more widely used in engineering practice. Robot and intelligent manufacturing technology represent the development level of a country's manufacturing industry and have become the key development fields and industries of developed countries in the world. However, as an important part of industrial robot technology, the application technology has not been paid enough attention to, which affects the application and popularization of industrial robot, and restricts the large-scale development of industrial robot industry itself. Researchers began to use computers to identify objects. The recognition
and expression of objects is a core problem of computer vision. The deeper recognition and understanding of perceived information is mainly reflected in the realization of three-dimensional reconstruction of objects. The so-called three-dimensional reconstruction is a method to calculate the three-dimensional coordinates of spatial points according to multiple images, and then to restore the spatial structure of objects. In this way, computer vision can simulate human eyes, carry out non-contact, automatic, fast, on-line detection and other characteristics, and have broad application value in industrial automation and human-computer interaction and other fields. Computer vision has developed rapidly since the 1950s, involving computer engineering, signal processing, mathematical statistics, neurophysiology and cognitive science. So far, computer vision is still in full swing. Nowadays, the theory and research of computer has been widely developed, and has gradually developed into a new subject which is integrated by pattern recognition technology, computer technology, control theory technology, artificial intelligence neural network and biotechnology. In the industrial field, the application of computer vision automatic detection technology can be seen everywhere. It has the characteristics of high precision, flexible function expansion, high reliability, fast speed, no contact and high cost-performance ratio, which greatly improves the production capacity and is a step further from the complete production automation.

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