Photoelectric Detection System for Large Board Parts

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Abstract. In-depth analysis of the current shortcomings in the detection of large board parts, a photoelectric detection method based on image processing technology is proposed, the overall structure of the detection system is designed in detail, the mechanical transmission system and the photoelectric detection system are specifically designed, and at the same time, the analysis the implementation steps of image processing for large-scale class parts using photoelectric detection technology are given. The specific implementation process is given, including: image acquisition, image stitching and image edge extraction, and finally the photoelectric online detection of large-scale board parts is completed.

Keywords: Large Class Parts, Photoelectric Detection, Image Processing

1. Introduction
The development of detection technology is an important manifestation of a country's technological level. In today's era, the rapid development of science and technology has increasing requirements for measurement accuracy, efficiency and automation. Therefore, traditional measurement techniques and methods have been gradually eliminated. The image processing system is a processing system that replaces the human eye for measurement and judgment, and converts the image signal into a digital signal based on the pixel distribution, brightness, color and other information through the image pickup device and the target [1-4]. Then use a certain regular algorithm to process these signal information and control the operation of the equipment. In addition, the image processing system can effectively improve the degree of production automation. In many cases, the accuracy and efficiency of human eye detection in industrial production is very low, but machine vision detection can often be greatly improved.

In the field of image acquisition, diversified optoelectronic vision theories have been formed for different use environments and their own characteristics. However, it is precisely due to the matching problem of the use environment that there are currently no large-scale products used. This situation is mainly caused by the imperfect theory of photoelectric vision [5-7]. With the development of optoelectronics, confidential metrology, computer technology and image processing technology, image measurement technology has gradually formed [8-11]. Such new precision measurement technology has been widely used in the fields of geometric size measurement and aerial remote sensing measurement.
2. Overall Design of Measurement System

In actual engineering applications, if the overall design is too complicated, it is difficult to adapt to harsh working conditions, and at the same time, it also brings difficulties to assembly and debugging. Therefore, a reasonable structure should be adopted to simplify the operation process.

2.1 Overall Design

The overall design plan consists of a control system, a mechanical transmission system, a photoelectric detection system and a computer digital image processing system. It is designed with a building block mechanism. The detection table can be spliced and lengthened according to the needs to meet the measurement of large plate parts of various lengths. When the whole system is running, the test piece moves along the slide rail at a constant speed, non-contact measurement of the test component, and digital image processing technology to process the collected images. The acquired digital image is transmitted to the computer through the transmission cable. The measurement results can be obtained in real time on the computer. Evaluate the quality of the tested parts and sort whether they are qualified. The overall design structure is shown in Figure 1 below.

![Overall structure design](image)

2.2 Mechanical System Design

Since the parts to be inspected by the entire system are the longest iron tower components, the probability of errors in movement is relatively high, so the camera must be accurately positioned. Therefore, we must combine the main structure of the mechanical transmission system with the mobile positioning components we select, so as to improve the collection accuracy of the tower punching position recognition system. Here we only briefly explain the main ideas and ideas of the design and composition of the mechanical transmission system in the entire system, which cooperate with the detection and positioning system we have determined, and realize the smooth operation of the overall detection system. The working principle of the mechanical transmission system is that the control system issues a drive command to the servo motor in the system, and the gear rotates through the coupling, and the gear and rack cooperate to form the transmission system.

In this system, the transmission system makes the visual inspection system and the positioning system move in a relatively uniform linear motion. The running speed is calculated by the number of revolutions of the servo motor and the ratio of the gears. Through the detection system that moves along the guide rail and compares with the previous positioning device, the over-center line and hole spacing of the tested part can be measured. When the positioning system is positioned, the guide rail is fastened to the workbench by screws. The positioning system is fixed on the platform, and the
The detection system moves relative to the fixed workbench, thus establishing the positioning of the camera movement. The speed of the servo motor drives the gear to cooperate with the rack through the coupling, so that the equipped visual imaging system can move in a uniform linear motion along the guide rail. If there are other needs for the detection speed, the speed of the servo motor can be adjusted through the encoder. Among them, the mechanical equipment with rack and pinion is adopted. Rack and pinion transmission is one of the most commonly used transmission forms in modern machinery manufacturing. Compared with other transmission forms, it has the following advantages to ensure a constant transmission ratio, a wide range of applicable loads and speeds, and a range of transmitted power. Large, compact structure, high efficiency, reliable work and long life.

### 2.3 Design of Photoelectric Detection System

CCD, controller host, controller, display, and computer digital image processing system constitute a complete optical inspection system. Compared with ordinary signals, the biggest feature of image data acquisition in the detection system is the large amount of data processing and high transmission rate. It is more convenient and quicker to process the hole shape and position of large plate parts after image acquisition. The photoelectric detection system is shown in Figure 2.

![Figure 2. Optical measurement system design](image)

When the system is running, the image captured by the camera is connected to the computer and the captured image is transmitted to the controller host. By setting the parameters of the controller host and modifying the software part, the captured image can be transferred to the computer Digital image processing. The processed image information and measurement results are then transmitted back to the controller host and displayed on the monitor in real time.

### 3. Image Processing

The collected image information of the iron tower components is processed by a series of specific operations, and the collected image information is converted by using hardware facilities such as computer image capture cards to obtain digital electrical signals. Various mathematical calculation methods can be used to process the collected images to improve the practical effects of the images to achieve the expected results of our detection. The image processing flow taken in this subject is shown in Figure 3.
Figure 3. Image processing flowchart

Since the content of the research is to perform online detection of the longest reachable tower under the premise of ensuring the detection accuracy, it is impossible for the camera to display all the image information with a picture in the existing technology. This must find a reasonable method to achieve continuous and complete image acquisition. The method used in this subject is to move the camera at a certain moving speed under the premise of determining the positioning system so that the parts under test can be collected regularly and continuously. Perform image stitching on the collected image data to restore the segmented image to the maximum extent to the real effect, which is convenient for further measurement.

3.1 Image Acquisition

In order to reduce the excessive accumulated error in the acquisition process caused by the excessive length of the iron tower component in the image acquisition, it is required to avoid the segmentation and interception of the empty space of the workpiece when the image acquisition of large plate parts is performed. Due to the harsh working environment of online detection, the selection of sampling point interval is a very important issue when sampling. It determines the quality of the image after sampling, that is, the degree of faithfulness to the original image. This is also the focus of image acquisition of large workpieces.

3.2 Image Fusion Stitching

Because the research is aimed at the measurement of the hole row size of the iron tower parts, it is not possible to collect the whole part picture at one time during the image acquisition. Therefore, it is necessary to perform image stitching after the image acquisition. For the overall measurement of the iron tower components, it is achieved through image restoration stitching and image recognition. The main flow chart of image restoration and stitching is shown in Figure 4.
3.3 Image Edge Detection
After performing a series of processing on the image, the shape and size of the test piece cannot be judged at this time, because the processing of the edge of the test piece has not been completed. If the recognition is carried out at this time, it will cause the distortion of the test result. One of the most basic characteristics of an image is the edge. In computer vision, image analysis and other applications, edge detection is not only an important part of image analysis and recognition, but also plays an important role in the recognition process. This is because the edges of the sub-images contain useful information for identification. Therefore, edge detection is the main feature extraction method for image analysis and pattern recognition. Edge detection is divided into three types: roof type, step type and flange type. These three types are divided according to the characteristics of their gray changes. Not suitable for this subject. The operator chosen in this paper is Roberts operator.

3.4 Part Hole Shape and Size Recognition
In actual engineering applications, in order to meet different practical conditions and suitable for different working environments, it is necessary to adopt various image recognition methods. The measurement environment of iron tower components is relatively complicated, and the general processing software is established on the basis of the laboratory environment, so the compilation of the part hole position recognition software system is selected for low working conditions, fast running speed, and simple operation software platform. After programming, the system can automatically measure the overall outline dimensions of the tower components and the behavior dimensions of the upper part holes. For the entire recognition system, the algorithm for calculating the telecentric coordinates of the part hole is particularly important, which directly affects the credibility and accuracy of the final data output.

The curve fitting method is used for the recognition algorithm of the part hole circle center coordinate. The curve fitting method is used because the image data collected by the camera may cause the outline of the details of some images to be unclear due to the influence of external factors, or even Some images have local distortions. Recognizing images by curve fitting is the best way to detect image changes caused by poor environment.

4. Summary
(1) Analyze the current shortcomings in the detection of large-scale board parts, propose a photoelectric detection method based on image processing technology, and design the overall structure and specific components of the detection system in detail.

(2) Analyzed the image processing steps of large-scale class parts using photoelectric detection technology, and gave the detailed implementation process, including: image acquisition, image stitching and image edge extraction. The article finally completed the photoelectric online of large-scale board parts. Detection.

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