Application of image feature extraction in water-proof steel plate counting of construction sites

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Abstract. As one of the commonly used construction techniques in waterproofing engineering of concrete structures, water-proof steel sheet is widely used in many large-scale projects. With the development of intelligent manufacturing industry, it is necessary to use intelligent terminal equipment to reduce labor input to achieve faster development and enhance their competitiveness. This article will focus on the way of waterproof steel plate purchase in the traditional construction industry, and still need to analyze the current status of manual inventory. Considering the inefficiency, low accuracy and early human investment of this method, a recognition method of waterproof steel plate based on image feature extraction in machine vision is proposed. Firstly, the original cross-section image of water-proof steel plate is extracted, then the image is pretreated by smoothing, segmentation and filling. Finally, the feature recognition and steel plate counting are realized.

1. Introduction
Water-proof steel plate is commonly used in engineering, mainly used in reinforced concrete structures, dams, subway and other underground projects. The use of water stop steel strip can change the water penetration path and prolong the water infiltration route. In the construction environment where leakage water may contain corrosive elements, the water-proof steel sheet can play a certain role in corrosion resistance. In the protection project, the use of steel plate to prevent water can ensure the protection effect of the project[1]. Therefore, in various large construction sites, water-stop steel is an indispensable raw material. A large number of watertight steel plates may be used every day for foundation construction. Due to the size deviation of purchased steel plates, it is not reliable to trade through simple weighing. Therefore, it is indispensable to carry out fast and accurate quantitative statistics of water-tight steel sheets before they are put into construction sites. However, at present, most construction enterprises still use manual counting method to count the stack of water-proof steel plates. This method is not only inefficient but also can not meet the requirements of counting accuracy. Therefore, in view of this, it is imminent to use what method to replace manual counting for construction sites[2].
With the continuous development and progress of machine vision technology, it has become a hot spot to explore how to use computer systems to process images. With the rapid development of science and technology, the speed of computer operation is faster and faster, the price of image acquisition equipment is gradually civilian, and the quality of image processing is getting higher and higher. Therefore, the application of image processing technology to steel plate counting has attracted more and more attention. In this paper, through collecting the image of the cross section of the waterproof steel plate, through a series of image processing to identify the number of steel plates, and In this paper, the number of waterproof steel plates is identified by collecting the sectional images of waterproof steel plates and a series of image processing. Finally, the worker gets the statistical results\cite{3}.

2. Preprocessing of sectional images of water-proof steel plates

Usually, the environment of the project site is complex, and it is very difficult to get the standard image quickly and accurately. Moreover, when the water-proof steel plate is loaded to the construction site, it is sometimes placed irregularly, and the close bonding between the steel plates is easily mistaken for a steel plate. At the same time, due to the position of the camera, the lighting conditions of the shooting environment are different, which will result in different images being extracted\cite{4}. All these problems will bring some difficulties to the later recognition of image features, so it is necessary to do some pre-processing of the image before the feature recognition.

2.1 Gray level transformation of target image

Firstly, the cross-sectional diagrams of stacks of waterproof steel plates are collected on the construction site by color cameras, as shown in Fig. 1 and Fig. 2. Then, the image is grayscaled. The grayscale image generally refers to an image that only includes luminance information without color information, that is, a black and white image that we usually refer to. Usually, the grayscale of images is the first step in image preprocessing\cite{5}. Because grayscale images generally only have 8 bits depth, so the operation of processing grayscale images is much smaller than that of color models, and the memory occupied is also relatively small. For cross-sectional images of watertight steel plates, simple color recognition is not very helpful for the final result. Using gray image can not only speed up the algorithm, but also make the image feature extraction more accurate. Therefore, image grayscale is the first step in image preprocessing\cite{6}. The color samples 1 and 2 are grayscale, as shown in figures 3 and 4.

![Figure 1. Color sample model 1](image1)

![Figure 2. Color sample model 2](image2)
2.2 Smooth filtering of target images

Image smoothing technology is often applied to image enhancement. This method is mainly to remove or suppress the noise in the image, and to highlight the useful feature information in the image. Image smoothing is often referred to as image filtering, and can be divided into linear filtering and nonlinear filtering. The most commonly used linear filtering methods are Gaussian filtering and mean filtering, because their noise suppression is more significant than other filtering methods. Image smoothing methods can generally change the original image information. But in this paper, Gauss filtering is used to preprocess the original image.[7]

Gauss filtering is sometimes referred to as Gauss ambiguity, which is widely used in image preprocessing. At the same time, the filtering method has a good inhibitory effect on the common Gauss noise. Generally, the application of Gaussian filtering in digital image is realized by convolution of Gaussian kernel and image. After convolution of such kernel and image, the filtering effect will be uniform in each direction. Although the image is smoothed by Gaussian filtering, the noise is suppressed, but the details of the edge are not weakened, which is a more practical filtering method. Among them, the effect diagram after filtering three is shown in figures 5, 6, 7, and 8. As can be seen from the effect map, although the noise is suppressed, the image also becomes blurred accordingly.[8]. In particular, the effects of Figures 7 and 8 are not conducive to later feature recognition, so the Gaussian filter kernel used herein is used for image denoising.

3. Feature extraction of water-proof steel plate in target image
After the image pre-processing, the remaining target areas in the graph are mostly separated steel plate cross-section. Therefore, if we want to count the number of steel plates, we need to mark the connected areas properly, so that we can get the area of each area to achieve the purpose of recognition and counting. In binary image processing, contour tracking algorithm is a common processing algorithm in image processing algorithms. It is mainly to mark the connection components in the image and extract the shape features in the image. The outline of the image is the most basic feature of the target area in the binarized image\(^9\). It is the dividing line between the target and the background in the binary image, which contains the basic information of the shape of the target area. Contour tracking algorithm, also known as edge point linking, is generally based on a contour pixel in a binary image. Search the next contour point adjacent to it in one direction, and then move on until the initial contour point is returned. The gray value of the cross section of the water stop steel plate is processed by two values, as shown in Figure 9.

![Figure 9. Two value image of cross section of watertight steel plate](image)

From the above diagram, we can see that the white area is the original target area, while the black area is a non-target area. And we can see that all the target areas in the image are processed by the contour tracking algorithm of multi-connected regions, and the contours obtained are basically correct\(^10\).

4. **Counting of cross section image of water-proof steel plate**

Feature extraction, recognition and counting of cross-sections of watertight steel plates are the last step of this paper. After all the steps of image pre-processing, the obtained image has been able to complete the corresponding counting processing\(^11\). At present, in the field of image processing, there are three classical methods for target recognition, namely, matching method, Hough method and support vector machine.

Among them, the matching method mainly uses known image templates or features to find matches in the image, and find the parts similar to the given image templates or features. The matching method can also be divided into template matching and feature matching. Template matching is to use a given template to perform sliding matching in the whole image, and to calculate the similarity between the pixel value of each region and the pixel value of a given template to determine whether this region is a given template image\(^12\). Feature matching is mainly by extracting some features of the target area in the image, and then using these features to match, calculate the corresponding similarity. Hough transform can detect the standard circle and straight line in the image, and transform the position coordinates of the pixels from the spatial domain. Finally, the pixels which conform to the linear or circular parameters in the parameter space are accumulatively counted. Support Vector Machine (SVM) firstly extracts features from the image, then maps the extracted features into a higher dimensional space, and then finds a segmentation plane with the largest interval. The larger the distance between the split plane and the feature, the smaller the total error of the classifier. Experimental analysis compares the results of the three methods on the recognition rate of steel plates. The support vector machine method has the highest recognition rate of steel plate samples compared with the matching method and Hough method. Therefore, this paper uses support vector machine method to identify technical aspects of water-proof steel plate\(^13\). The whole process of steel plate counting based on feature extraction is shown in Figure 10.
5. Conclusion
In recent years, the field of machine vision has developed rapidly. With the continuous optimization of various algorithms, machine vision technology has been applied to all walks of life, and has achieved good results. Considering that the counting of a large number of water-proof steel sheets in construction sites is still using manual counting mode, not only the accuracy and efficiency cannot be effectively guaranteed, but also a large number of labor costs, low economy. Therefore, in order to meet the counting requirements of construction sites, this paper combines image feature extraction technology. Under the premise of many image preprocessing on the original cross-section of the water-stop steel plate, such as image graying, image smoothing, image segmentation and image filling, the useful features are effectively identified by the support vector machine method. The recognition results show that the recognition rate is high and the method is reasonable. Finally, the whole set of image processing ideas and processes also provide a solid theoretical basis and problem breakthrough for future researchers to deal with similar problems.

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