Research on fast image segmentation algorithm based on machine vision

Zou Wangping

Information and Technology Department, Chizhou Vocational and Technical College, Chizhou, Anhui, 247100, China

Keywords: machine vision; Damage image; Segmentation correction

Abstract: The machine vision system converts the captured object into image signal through the image capturing device, which is transmitted to the special image processing system, and then transformed into digital signal according to the pixel distribution, brightness, color and other information. Machine vision system can quickly obtain a large amount of information, and it is easy to process automatically, and it is also easy to integrate with design information and processing control information. According to the characteristics of the damage images collected by the micro imaging system, the rapid judgment of the damage in the irradiation area and the automatic extraction technology of the damage area are studied. According to the obvious peak value of the histogram of the difference image before and after the damage, a damage discrimination algorithm based on the gray distribution characteristics is proposed. The algorithm only depends on the gray distribution statistics of the difference image before and after the pulse laser irradiation, which reduces the difficulty of image processing and can quickly and effectively detect whether the damage occurs.

1. Introduction

Machine vision system refers to the use of machines to make various measurements and judgments instead of human eyes. Machine vision is a very important research field in the field of engineering and science. It is a comprehensive discipline involving many fields such as optics, machinery, computer, pattern recognition, image processing, artificial intelligence, signal processing and photoelectric integration. Its ability and application scope are gradually improved and popularized with the development of industrial automation, The rapid development of mother child image sensor, CMOS and CCD camera, DSP, ARM embedded technology, image processing and pattern recognition has effectively promoted the development of machine vision. Machine vision is a complex system. Because most of the things monitored by the system are moving objects, the matching and coordinated action between the system and moving objects is particularly important, which brings strict requirements to the action time and processing speed of each part of the system. [1] In some application fields, such as robot and flying object guidance, there will be strict requirements for the weight, volume and power consumption of the whole system or part of the system.

2. Machine vision system

On the production line, people will make errors and errors due to fatigue and differences between individuals, but the machine will continue tirelessly and stably; In some dangerous working environments that are not suitable for manual operation or where artificial vision is difficult to meet the requirements, machine vision is often used to replace artificial vision. In terms of its detection nature and application scope, machine vision system is divided into quantitative and qualitative detection, and each type is divided into different subcategories. Machine vision is very active in various application fields of industrial on-line detection, such as visual inspection of printed circuit board, automatic flaw detection of steel plate surface, parallelism and verticality measurement of large workpiece, container volume or impurity detection, automatic identification and classification of mechanical parts, geometric dimension measurement, etc. In addition, in many

  DOI: 10.25236/icmmct.2022.041

occasions where other methods are difficult to detect, it can be effectively realized by using machine vision system.[2] The application of machine vision is increasingly replacing people to complete a lot of work, which undoubtedly improves the level of production automation and the intelligent level of detection system to a great extent

The advantages of machine vision system are: (1) Non contact measurement will not cause any damage to the detected object, and improves the reliability of the system; (2) Wide spectral response range, such as infrared measurement invisible to human eyes, to expand the visual range of human eyes; (3) Working stably for a long time, it is difficult for humans to observe the same thing for a long time, while the machine vision system can do the tasks of measurement, analysis and recognition for a long time. The application field of machine vision system is more and more extensive. It has been widely used in industry, agriculture, national defense, transportation, medical treatment, finance and even sports, entertainment and other industries. It can be said that it has penetrated into all aspects of our life, production and work.

A complete machine vision system includes: lighting source, optical lens, CCD camera, image acquisition card, image detection software, monitor, communication unit, etc.

(1) When the sensor detects that the detected object is close to moving to the shooting center of the camera, it sends the trigger pulse to the image acquisition card;

(2) The image acquisition card sends the start pulse to the lighting system and camera respectively according to the set program and delay;

(3) A start pulse is sent to the camera, the camera ends the current photographing and starts a new photographing, or the camera is in a waiting state before the start pulse arrives, starts after detecting the start pulse, and opens the exposure component before starting a new photographing (the exposure time is set in advance); Another start pulse is sent to the light source, and the opening time of the light source needs to match the exposure time of the camera; The camera scans and outputs an image;

(4) The digitized video signal is directly received by the digital A / D camera after digital data acquisition;

(5) The image acquisition card stores the digital image in the memory of the computer;

(6) The computer processes, analyzes and recognizes the image and obtains the detection results;

(7) The processing result controls the action of the pipeline, carries out positioning, corrects the error of motion, etc.

3. Digital image processing

Digital image processing is computer image processing, which refers to the process of transforming the image from analog signal to digital signal, and using the computer to denoise, enhance, restore, segment and extract features of the image. After image processing, the output quality is greatly enhanced, which not only improves its visual effect, but also facilitates the computer to complete the subsequent analysis and processing.

Image is one of the main sources for human beings to obtain and exchange information. Image processing has been widely used and made remarkable achievements in many aspects of human life and work, such as aerospace technology, communication engineering, biomedical engineering, industrial detection, culture and art, military security, e-commerce, video and multimedia systems, Image processing has become a promising new subject. Although digital image processing technology has made many important research achievements, there are still some difficulties: (1) large amount of information processing. The information of digital image processing basically exists in two-dimensional form, the amount of processing information is large, and there are relatively high requirements for the speed and storage of the computer. (2) Wide bandwidth. In the realization of image imaging, transmission, display and other links, the cost is high and the technical implementation is difficult, which requires higher frequency band compression technology. (3) Pixel correlation is large. Each pixel in digital image is not independent. Many pixels have the same or similar gray level and have great correlation. Therefore, information compression has a great room for improvement. (4) You cannot reproduce all geometric

information about a 3D scene. Image is a two-dimensional projection of three-dimensional scenery, so new measurements or appropriate assumptions must be added to understand and analyze three-dimensional scenery. (5) Human factors have a great influence. After digital image processing, images are generally observed and analyzed by people. Human vision system is very complex. Machine vision system also imitates human vision. Human perception mechanism restricts the research of machine vision system.[3]

In the process of industrial production automation, digital image processing technology is one of the most effective methods to realize product real-time monitoring and fault diagnosis and analysis. With the further development of computer software and hardware, thinking scientific research, pattern recognition and machine vision system, this method will be promoted to a higher and deeper level.

4. Digital image processing

There are many application tools for digital image processing, which can be divided into three categories:

The common point of the first kind of tools is to transform the image into other domains for processing, and then transform it into the original domain for further processing, such as image filtering and orthogonal transformation.

The second kind of tools are image processing directly in the spatial domain, such as differential equation method, statistical method and other mathematical methods.

The third kind of tools is different from the methods usually used in spatial domain and frequency domain.[4] They are operations based on random sets and integral geometry, such as mathematical morphological operations.

The research contents of digital image processing mainly include the following aspects:

(1) Image transformation. In order to get a more simple and convenient image function, the image is generally transformed. The forms of image transformation mainly include optical and digital, which correspond to continuous function and two-dimensional discrete operation respectively. The commonly used methods include Fourier transform, Walsh Hadamard transform, discrete kafner levy transform and other indirect processing techniques.

(2) Image enhancement and restoration. Its purpose is to improve the quality of the image and improve the definition of the image. Image enhancement can highlight the information of interest in the preprocessed image. The common methods include gray transformation, histogram processing, sharpening filtering and so on. Image restoration can restore the degraded image, and the method of filter restoration is often used.

(3) Image compression. This technology can remove redundant data, reduce the amount of data required to describe the image, and realize fast transmission and storage of image data. Image compression is divided into lossy compression and lossless compression. Lossless compression is mainly used in filing and preservation and other aspects requiring image quality. Compared with the former, lossy compression can achieve a higher degree of compression, but the generated image is not as good as the original image.[5]

(4) Image segmentation. Image segmentation is to classify the pixels in the image and subdivide the image into several meaningful sub regions, such as regions and edges in the image. After decades of research, on the basis of various theories, there are thousands of image segmentation algorithms, but because these algorithms are proposed for specific problems, there is no general segmentation algorithm. With the combination of various new technologies and theories, image segmentation algorithms will make greater breakthroughs and progress.

(5) Image description. The description of the segmented region is the early step of image automatic processing. The representation of the region is related to two basic choices: the representation of the region with external features and the representation of the region with internal features. No matter what representation scheme is selected, it is for the convenience of computer processing. The methods of image description include curve fitting, Fourier descriptor based on arc length and polar radius, moment description and chain code.

(6) Image classification and recognition. Image recognition is to recognize the research things according to some features, which belongs to the category of pattern recognition. Its main content is to segment and extract the features of the preprocessed images, and then identify and classify them. Image recognition generally adopts statistical recognition method, fuzzy recognition method and artificial neural network classification method.

5. Conclusion

5.1 Image acquisition

In general, the image acquisition of image recognition algorithm based on machine vision mainly depends on the camera, and the camera will take. The purpose of image preprocessing is to reduce the working pressure of subsequent image processing, denoise, enhance and compensate the image in advance, and provide the image with high definition. Now there are thousands of image recognition algorithms, but the core is edge detection, image segmentation, image binarization, gray detection and other technologies. In the process of image preprocessing, according to different image recognition algorithms, different eigenvalues, gray values and other parameters can be processed in the preprocessing stage. The quality of the processing results has a direct impact on the final analysis results. Among them, edge detection belongs to the research problem in low-level vision and is the basis for the execution of middle and high-level tasks such as image enhancement, feature extraction and image segmentation [2]. The purpose of image segmentation is to preserve the feature targets from more complex images, but how to extract the feature targets efficiently from complex images has always been a research hotspot. Image binarization is to set the pixels of the whole image to 0 or 255 to make the image appear black-and-white effect, greatly reduce the amount of data in the image and highlight the image contour.

5.2 Eigenvalue extraction

Feature selection has a great impact on the speed and accuracy of image recognition. Feature extraction uses computer to extract image information and decide whether each image point belongs to an image feature. The function of feature extraction is to divide each point on the image into different subsets, such as isolated points, continuous curves, continuous regions and so on. Usually, the image features are color features, texture features, shape features and local features.

5.3 Image Matching

Image matching is not used to judge whether the two images are the same, but to study and judge the similarity between the two images, and the similarity between the images changes with the requirements of the algorithm. In general, the similarity we use is to use the image matching algorithm to judge the objects in two different images. Due to the complexity of the image and the different illumination, angle and environment during image acquisition, it is necessary to select appropriate feature points to simplify the image and enhance the recognition accuracy.

Acknowledgement

(1) Key projects of natural science research in Anhui Universities in 2021 (kj2021a1417)

(2) Academic support project for top-notch talents in disciplines (majors) in Colleges and universities in 2021 (gxbjzd2021119)

(3) 2021 provincial quality engineering project of colleges and universities (2019cxtd045)

References

[1] Zhu Z T, Zhang B, Yang G . Research on Fast Capsule Image Segmentation Algorithm[J]. Applied Mechanics & Materials, 2012, 236-237:989-993.

[2] Wang Y, Huang X, Yu H , et al. Research on Image Segmentation of Touching Rice Based on

Machine Vision[J]. Journal of the Chinese Cereals and Oils Association, 2018.

[3] Ge L, Li D, Liu Y, et al. Image Segmentation of Pseudo-foreign Fibers in Cotton on the Basis of Improved Genetic Algorithm[C]// International Conference on Computer & Computing Technologies in Agriculture. Springer, Berlin, Heidelberg, 2011.

[4] Jiang Y, Wang Y, Gao H, et al. Research on key technologies of medicine grain defect detection system based on machine vision. 2015.

[5] Yujing H E, Yang Y, Sun W, et al. Research on Agricultural Machinery Automation based on Computer Vision Recognition Technology. 2016.