Sensors & Transducers, Vol. 183, Issue 12, December 2014, pp. 233-239

Sensors & Transducers

The Research of Cannonball Fuze Loading Detection Based on Image Information Processing Technology

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Received: 18 August 2014 /Accepted: 20 October 2014 /Published: 31 December 2014

Abstract: Nowadays there are problems such as neglected loading and mistaken loading of cannonball fuze in practical manufacture. If the workers redetect them, they should knock down the cannonball one by one, but it is inefficiency and dangerous. In this paper it introduces a system that detects and judges automatically the loading of cannonball fuze based on computer aid technique, image processing technique. The productivity is improved. The software of the system is developed by Visual C++. *Copyright © 2014 IFSA Publishing, S. L.*

Keywords: Image information processing technology, Cannonball, Fuze loading, Design and implement, Visual C++.

1. Introduction

The computer aid detection technique is widely used in industrial production and detection. The detection of finished product and substandard goods in production line largely depend the development of image processing technique. Now it is widely used to detect by manual working through eye-measurement. This method has strong subjectivity and high erroneous judgments' rate. And the workers' eyes easily feel tired so as to lower detection rate. But with the computer aid technique to realize the intelligentized detection, erroneous judgments' rate could be lower, productivity could be increased and the product costs could be reduced [1, 3, 5].

Nowadays there are problems such as neglected loading and mistaken loading of cannonball fuze in practical manufacture. If the workers redetect them, they should knock down the cannonball one by one, but It is inefficiency and dangerous. It is useful to reduce the workload of the workers, to increase the work efficiency and to better the conditions of the workers.

In this paper it introduces a cannonball fuze image processing system based on computer aid technique, image processing technique. It detects and judges automatically the loading of cannonball fuze and give the detect result. At the same time, it enlarges the use of computer aid image processing technique.

2. The Introduction of the Cannonball Fuze Image Processing System

The cannonball fuze image processing system is used to detect the loading in cannonball fuze. The flow is that after taking pictures of the detected cannonball, the pictures are inputted to the system by program interface. Then the processed image features are chosen by the system. The chosen features are compared through pattern recognition and then to detect the image. At last the system records the detected result to let people analyze and use. The processing flow is as Fig. 1. Here it does not introduce the image collecting part any more [4].

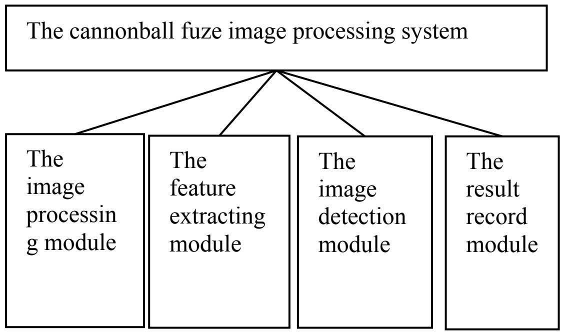


Fig. 1. The function of cannonball fuze image processing system.

It chooses the open operation, close operation, peak threshold subdivision, outline extracting, boundary detection, and statistics pattern recognition as the image processing and recognition technique.

2.1. The Image Processing Module

It processes the collected target images to be more suitable for comparison so as to improve the detection and judgment accuracy rate of the system. It uses the methods of open operation and close operation to preprocess the detected images.

2.2. The Feature Extracting Module

Based on peak threshold subdivision and outline extracting, it extracts information from the target images to use in pattern recognition. It extracts the physical dimension and gray level characteristic parameters of the specified location from images of the cannonball fuze loading correctly. And it detects the images by reference to the characteristic parameters.

2.3. The Image Detection Module

It detects the cannonball fuze loading by comparing the physical dimension and gray level characteristic parameters of the target images.

2.4. The Result Record Module

It marks the abnormal images, counts the detection result at last, outputs and displays the result. According to this, the workers could check the number of the cannonball, find the abnormal cannonball fuze loading. And it could judge the quality of the workers.

3. The Implement of the Cannonball Fuze Image Processing System

3.1. The Image Processing Module

In reality, during the procedure of form, transfer, accept and process, the acquired images could be disturbed outside or inside unavoidably. For example, the heterogeneity of sensor's sensitivity during the light changes to electricity, the quantization noise during digitization, the error and human factor during transfer, and so on, could all lead to a certain extent noise disturb. The noise makes the quality of the image worse, the image vague, feature drowned, so that it is difficult to analyze. So, it is important in the image processing to remove the noise and recover the original image.

It processes the acquired image using open operation or close operation according to different conditions in the image processing module. Then the image is more suitable to compare so as to improve the detection and judgment accuracy rate of the system.

3.1.1. The Design of Image Open Operation

The comparison procedure of erosion first and then expansion is called open operation. After open operation, the original image could remove isolated small dots, spikes and propons, remove wisp, smooth the boundary of large object. And at the same time it does not change the area obviously.

The flow of open operation is as Fig. 2.

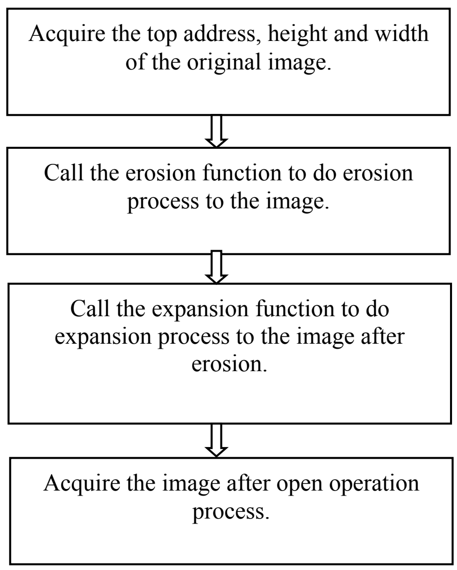


Fig. 2. The flow of open operation.

3.1.2. The Design of Image Close Operation

Close operation is a procedure of expansion first and then erosion. It is used to fill the small hole in object, connect near object, smooth its boundary. And at the same time it does not change the area obviously.

The flow of close operation is as Fig. 3.

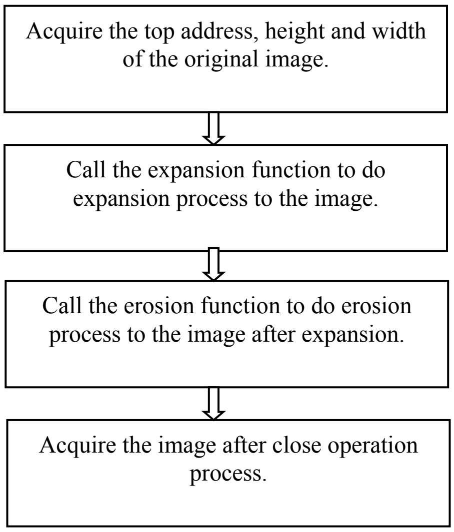


Fig. 3. The flow of close operation.

3.2. The Feature Extracting Module

Based on peak threshold subdivision and outline extracting, it extracts information from the target images to use in pattern recognition.

3.2.1. The Design of Peak Threshold Subdivision

The operation staff could choose suitable threshold by drawing grey histogram of the target image. The system does subdivision process to the target image according to the selected threshold. The key point of subdivision is to determine the threshold. If we could define a suitable threshold we could subdivide the image correctly. After defined the threshold, compare the threshold with the grey level of the pixel value could be processed parallel with grey level subdivision. The subdivision result could directly show the image area. The flow is as Fig. 4.

3.2.2. The Design of Contour Extracting

It extracts the geometry feature of the target image so as to compare and recognize.

The contour judge rule is that read the eight neighborhood pixel value of the pixel dot into an array. If the difference between the grey value of every neighborhood pixel and the grey value of centre point is less than 10, then consider the neighborhood pixel is equal to the centre point. If all the eight neighborhood pixels are equal to the centre point, set white to the pixel dot in the memory, otherwise keep it the same. The flow of contour extracting is as Fig. 5.

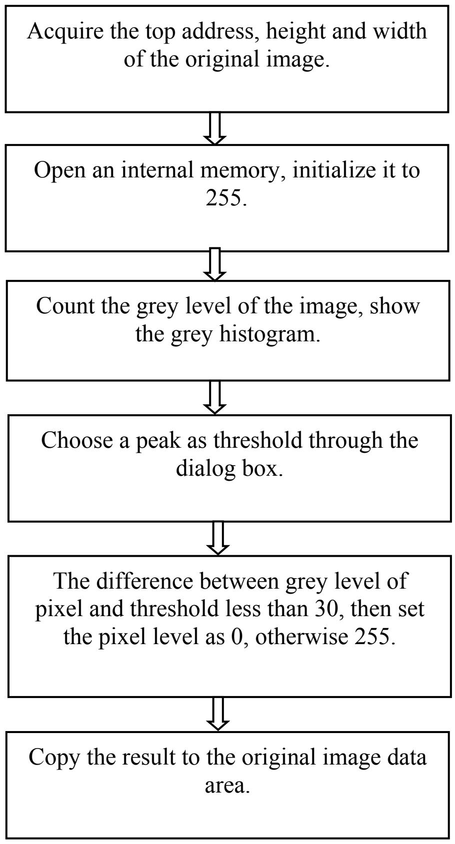


Fig. 4. The flow of peak threshold subdivision.

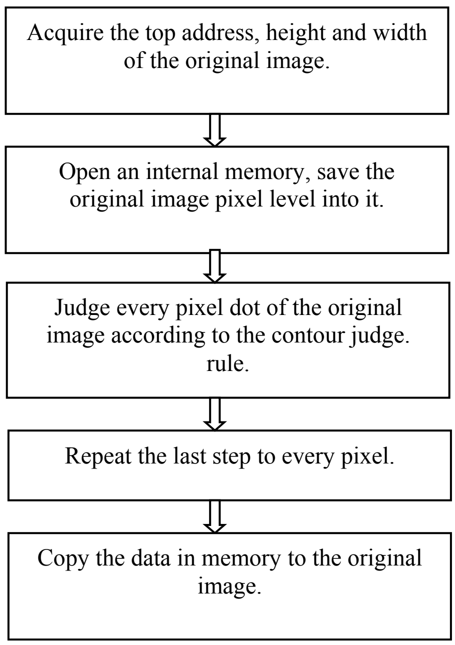


Fig. 5. The flow of feature extracting.

3.2.3. The Design of Boundary Tracking

It extracts the geometry feature of the target image so as to compare and recognize. Boundary tracking could describe the geometry feature more accurately than contour extracting does.

The method of boundary tracking uses a set of the image as input, and outputs an ordered border set. Boundary tracking determines whether a pixel dot is a boundary or not based on all information of an image.

The flow of boundary tracking is as Fig. 6.

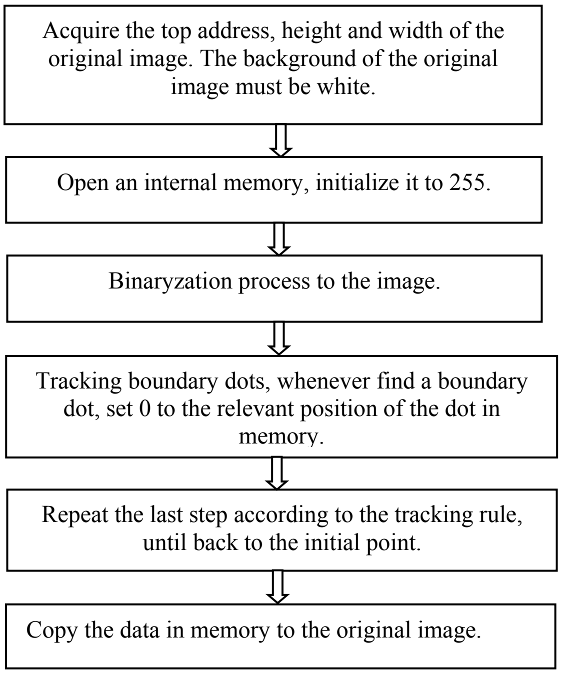


Fig. 6. The flow of boundary tracking.

3.3. The Image Detection Module

It can be learned from test that after image through peak threshold subdivision, the circular hole of the abnormal loading fuze is more smooth and regular than that of normal loading fuze, and the shape is closer to circle or oval. So, here the morphology feature of the hole could be used to identify the abnormal loading cannonball fuze. The system uses a structure of layering and classification. The morphology classify is the first step to do classify process, that is broad classification. Through broad classification, the majority of normal loading cannonball fuze could be removed, while keeping less suspicious images to be identified later by human. By this way the identify efficiency of the system improves efficiently.

In this method, the main morphology feature of the hole includes the area (A) of the hole, roundness (C), rectangularity (R) and elongation (E). When get the four morphology feature above, it uses the way of boundary tracking to the two-valued subdivision image, get its chain code so as to get its morphology feature.

The perimeter of the circular hole area circled by chain code, that is the length of the chain:

$$L = ne + \mathrm{no}\sqrt{2}\,, \tag{1}$$

In (1) ne represents the even level chain number, no represents the odd level chain number.

The roundness of the circular hole area:

$$C=4\Pi A/L\times L, \tag{2}$$

The roundness describes the deviation scale between the circular hole area and circle. At the same area, if the boundary of the circular hole area is smooth and is circle, then the perimeter is the shortest, the original roundness C is 1. The more deviated of the circular hole area to circle, the least the C is.

The rectangle level of the circular hole area:

$$R = A/(W \times H), \tag{3}$$

where W is the width, H is the height. The rectangle level describes the deviate of circular hole area to rectangle. When circular hole area is rectangle, then R is the maximum value 1.

The elongation of the circular hole area:

$$E = \min(W,H)/\max(W,H), \tag{4}$$

The more longitypical the circular hole area is, the least the E is. When the circular hole area is circular is 1.

After the system has learned many times and got correct data of the parameters above, when identifies the target images, most of the abnormal images could be identified and the system will point out a warning. Then the workers will identify the second time to determine at last if the loading image is abnormal or not.

3.4. The Result Record Module

The function of the result module is to divide the processed images into two parts, one is normal loading and the other is abnormal loading, and then saves the images into two different folders. After the workers have identified all the images, they will check the corresponding cannonball according to the serial numbers of the images saved in the abnormal folder, and then do poorly done work over again.

4. The Result of the System

4.1. The Original Image of the Cannonball Fuze

The X-ray image of the cannonball loading fuze is as Fig. 7. From Fig. 7 we could know clearly the image of normal loading and abnormal loading.

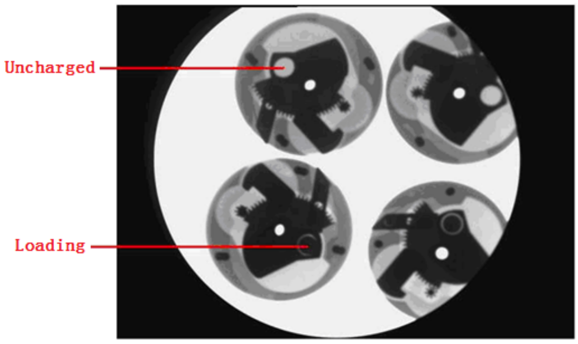


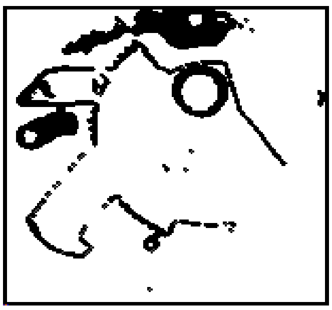
Fig. 7. The contrast X-ray of the cannonball fuze loading.

4.2. The Result of Image Processing Module

The image after open operation will remove isolated dots, spike and ponticulus (small dot connect two areas).The image after open operation is shown in Fig. 8.

The image after close operation will fill the small hole in object, connect near object and smooth the surface of the image. is shown Fig. 9. The image after close operation is shown in Fig. 9.

(a) unloading



(b) loading

Fig. 8. Image after open operation.

4.3. The Result of Feature Extracting Module

Statistic the grey level of the image and draw the histogram of the image according to the grey level information. The workers chose the suitable threshold based on the histogram.

After the peak threshold split image is processed, the morphologic feature will be shown. So the system could get the relevant morphologic feature of the image, as Fig. 10.

After contour extracting image is processed, the morphologic feature will be shown. So the system could get the relevant morphologic feature of the image, as Fig. 11.

After boundary tracking image is processed, the morphologic feature will be shown. So the system could get the relevant morphologic feature of the image, as Fig. 12.

Fig. 9 (a). Image after close operation: unloading

Fig. 9 (d). Image after close operation: loading.

4.4. The Image Detection Module

After lots of identify training, the result of the detecting target image is as Fig. 13.

4.5. The Result Record Module

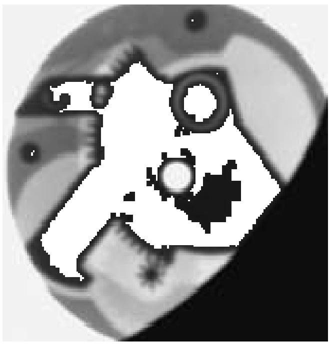
The identified image is saved into two different folders for the workers to check later. The whole system is developed by VC++, we will not introduce the detailed code here [2].

(a) unloading

(b) loading

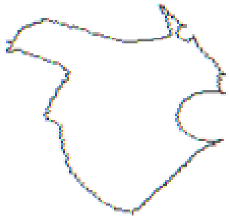
Fig. 10. Image after peak threshold split.

(a) unloading

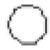


(b) loading

Fig. 11. Image after contour extracting.



(a) unloading



(b) loading

Fig. 12. Image after boundary tracking.

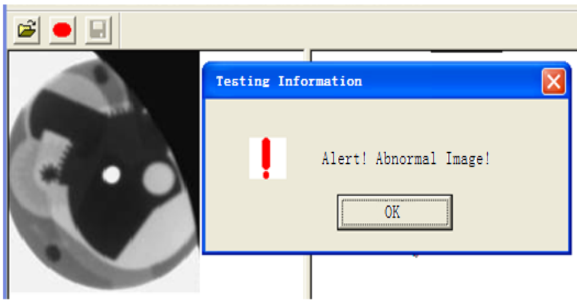


Fig. 13. The detecting result.

5. Conclusion

It uses the X-ray technique to take a picture of the detected cannonball, and get the X-ray image. The image is processed through computer aid image processing technique and pattern recognition technique, and then to detect the loading situation of cannonball fuze.

It realizes the detection of cannonball fuze loading based on computer aid image collecting, image processing, image identifying, image comparison technique. Thus it could solve quickly and safely the problems that often appear in industry.

Acknowledgements

The author acknowledges the support of Project supported by Beijing Union University (Grant No. 2k200958b).

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