I. INTRODUCTION

Image-matching is mainly used in two or more images' matching and fusion in different times, different perspectives, different sensors different angle of view and different photography condition, and it also will be a basic problem in image-processing [1].

Usually, the two or more images will be different by using the same or different sensors (imaging devices) for the same scene under the dissimilar condition (weather, photographs position and so on). The difference of a plurality of images in the same scene can be expressed: different resolution, different gradation attribute, different position (translation and revolving), different scale, different nonlinear transformation and so on. In order to analyze the different scenarios, it requires integrating data from those images, and the image-matching criterion is the critical step for the fusion data [2].

The image-matching has the practical significance such as remote sensing image-processing, computer vision, medical applications, target identification, environmental monitoring, weather forecasting and geographical information processing and so on.

In industrial production, a variety of detection, identification and other requirements will be encountered [3]. For instance, in PCB production line, the wiring connection needs to be detected. In the production of electronic components, the pin and circuit of chips must be checked. Then the image-matching technological advances in today's society helped cultivate the path for the development of chips' defect detection, thus, increasing the roles they play that vary from industrial applications to complex educational and entertaining projects [4].

II. THE BASIC THEORY OF CHIPS' IMAGE-MATCHING

a. The principle of chip image-matching

Image-matching is mainly used to solve the strict alignment of several images, chips image-matching refers to seek for a kind of correlation in space that make it consistent with the corresponding point in the other standard image [5].

Because of the different photography condition, one of the two images, which is photographed in different angle, different position from one chip can only reflect certain aspects of the characteristics.

III. THE REALIZATION OF CHIPS' DEFECT EXTRACTION ALGORITHM

While image-matching achieved in this chapter, the relative spatial locations of the two images will be used in similarity measuring, Optimizing location parameter, making errors minimal, and eliminate the errors in registration so as to achieve registration. It is shown in Figure 1.

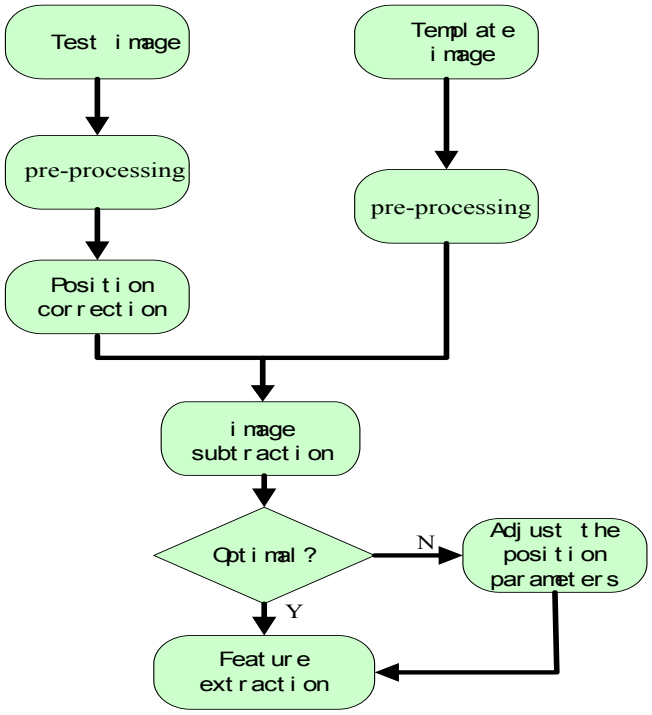

Figure 1. The flowchart of chips' image-matching

a. Image pre-processing

When the two-dimensional chips' images are captured by CMOS cameras, some noises are added to the image to cause the image distortion, and then the two-dimensional images of chips are unable fully to manifest the complete information as a result of the influence of tool or method in obtaining images. Therefore, it is extremely necessary for pre-processing before the implementation of the various types of image processing method. The image of quality can't be taken into account after pre-processing, but it only selects and highlights the interest features.

Pre-processing methods in this article are divided into the following four steps:

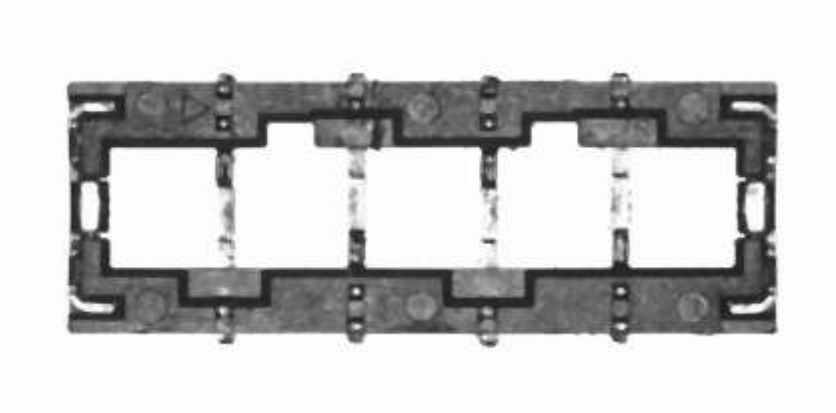

Figure 4. Image after median blur

a.iii Iterative segmentation

Image segmentation algorithm can be divided into two categories: image segmentation based on threshold and image segmentation based on edge. The gray value will be selected to distinguish whether it is target or not by using image segmentation based on threshold, which is equivalent to image binaryzation. Generally, threshold is calculated by histogram [8].

However, the image edge is applied to divide target into image by using image segmentation based on edge. The boundary in different image has generally an obvious edge which is used to segment image. In the context of this paper, image segmentation based on threshold is applicable.

The basic idea of iterative segmentation is: at first, an estimate threshold is set and a certain algorithm is used repeatedly to amend the estimated value in order to guarantee the revised results are superior to the previous. After a certain number of amendments, the results tend to converge, that is, the difference between the neighboring two results is small [9]. When the difference is small as an acceptable range, it indicates that an ideal threshold is found.

The result of iterative segmentation is as shown:

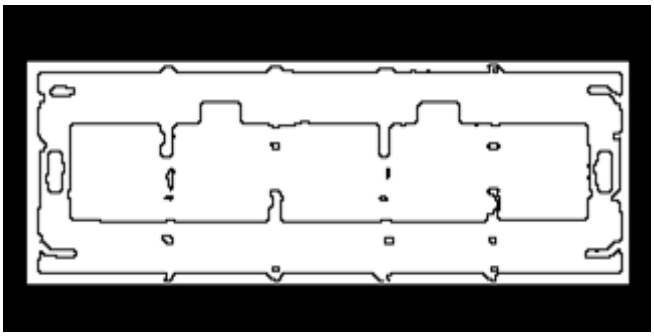

Figure 8. Temple image after pre-processing

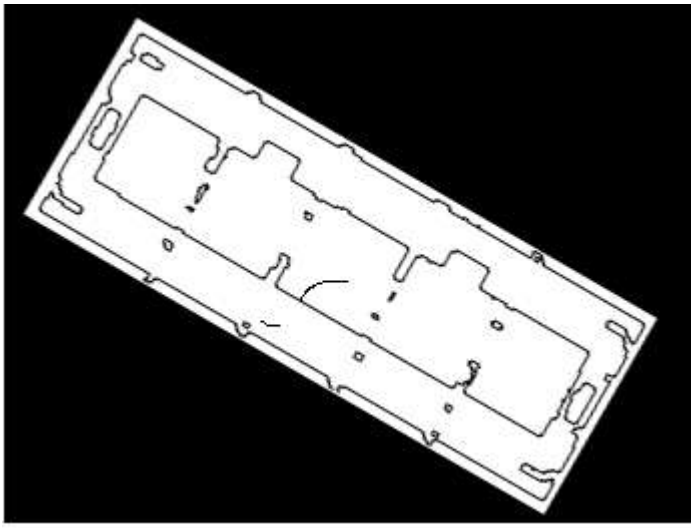

Figure 9. Test image after pre-processing

b. The adjustment of invariant moments

b.i Geometry moment of image

It needs to operate the pattern and the search space according to the image invariant in image-matching and image recognition. Consequently, Seeking for the invariant of image become a key and difficulty point in image-matching algorithm [10].Since the images' gradation has the displacement invariability, the pixel points are always selected as the invariant of image in the points' pattern matching. However, when changes in the scale or angle are large, the grayscale of the image is incompetent for invariants.

With the knowledge of mechanics, m_{20} and m_{02} is respectively inertia around the x and y axis. Assuming that a line passes through points (a, b) and has the angle named θ with the x-axis could satisfy:

$$(x-a)\sin\theta-(y-b)\cos\theta=0 \tag{3}$$

Then f (x, y) around the inertia of line is

$$\iint_{\xi}[(x-a)\sin\theta-(y-b)\cos\theta]^2 f(x,y)dxdy=0 \qquad (x,y)\in\xi \tag{4}$$

A line which causes its inertia to be smallest would be found. The derivation of the formula (4) on a or b, and make it equal to zero, then the next formula will be obtained:

$$\iint_{\xi}[(x-a)\sin\theta-(y-b)\cos\theta]\ f(x,y)dxdy=0 \tag{5}$$

According to geometric moments, the above formula can be written as

$$m_{10}\sin\theta-am_{00}\sin\theta-m_{01}\cos\theta+bm_{00}\cos\theta=0 \tag{6}$$

Simplify the above equation:

$$(\bar{x}-a)\sin\theta-(\bar{y}-b)\cos\theta=0 \tag{7}$$

As can be seen, minimum value is

$$a=\bar{x},\ b=\bar{y} \tag{8a, b}$$

Accordingly, the inertia of the smallest inertia line is:

$$\iint_{\xi}[(x-\bar{x})\sin\theta-(y-b)\cos\theta]^2 f(x,y)dxdy \tag{9}$$

Thus it can be seen that the minimum inertia line passes through the center $(\bar{x},\bar{y})$ and also has an angle with the x-axis:

$$\theta=\frac{1}{2}\tan^{-1}\left(\frac{2\mu_{11}}{\mu_{20}-\mu_{02}}\right) \tag{10}$$

4) The invariant moment of image

From above formula, the differences characteristics between two images' shape are attributed by different bands of geometric moments and center moments. The so-called invariant moments'

images. The high speed examination can be achieved by subtraction method because of its simple and high efficiency. $f(x,y)$ and $g(x,y)$ respectively represents the template and test image, meanwhile, $s(x,y)$ is the result of subtraction:

$$s(x,y) = f(x,y) - g(x,y) \tag{11}$$

c.ii Realization of subtraction

In the process of subtraction, dynamic datum image is selected: the subtraction between test image and template image. A template image in front will be selected as the datum image for subtraction, so the speed is slow. Upon this, the differences between two images can be minimized. Moreover, with its good reliability and accuracy, accumulated errors which are caused by poor performance will be avoided [12].

In the process of subtraction, negative gray value named negative subtraction will appear. Of course, the negative subtraction needs to be negated. Similarly, positive gray value named positive subtraction will appear. The positive and negative subtraction may appear at the same time. Therefore, the combination of positive and negative subtraction is used to reduce the registration error. The result of subtraction is as shown:

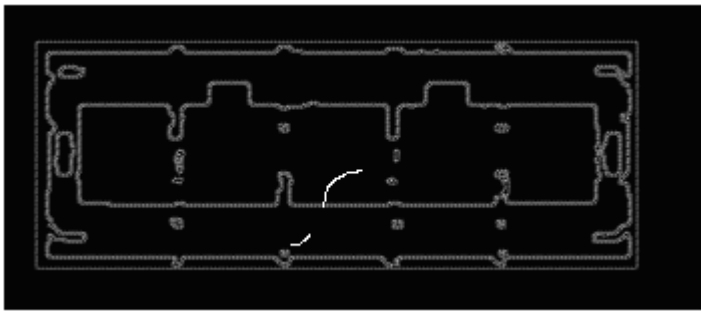

Figure 12. Test image after subtraction

From Figure 3-9, the defect parts have already appeared. However, the problem is that the unnecessary parts are not completely removed, and then the error must be eliminated. The experience shows that the gray level difference exists in defective parts and the residual parts. Upon this, the threshold is set to split them. Generally, the grayscale value of residual parts is 180~220, the grayscale value of defective parts is 230~250, therefore, suitable threshold is selected as 225.

and it has widely prospects in defects detection.

V. CONCLUSIONS

This project is from an enterprise, unlike artificial vision; a relatively new method named automatic detection is put forward to solve the actual problems in chips' defect examination. These works have been mainly completed in the article:

(1) Pre-procession for images. First of all, gradation processing is used, and then the image will be smoothed after gradation, and so iterative threshold will be carried on. At last, detection is appeared for the next process by contour extraction.

(2) Invariant moment correction for images. The offset angle and location of the image will be calculated to correct by using invariant moments, and it is one of the highlights in this article.

(3) Image-matching. Registration must be carried on when image correction is completed. In this article, subtraction is put forward to reflect on template selection and combination of positive and negative differences. Dynamic template is selected to eliminate outside interferences. After matching, the error is continued to eliminate. The experience shows the defect information is obtained to prepare for the classification by using threshold [13].

Weaknesses and shortcomings of the algorithm in this article:

(1) Because of all kinds of defects on chip, the partial flaw extraction is finished in this article. Other types of defects will be added to examine so as to achieve the integrity of the system and the needs of actual production.

(2) At present, the experimental condition is idealization. Registration algorithm is not used to the actual production in the system. The off-line research is also lack of the depth. In addition, the timeliness of algorithm also needs to be improved.

In conclusion, the defects can be identified by the algorithms. However, any computer method can't determine exactly as the eyes. Therefore, the strict template image must be adopted to ensure qualified products after detection. There are qualified products in scraps, the 10% qualified products can be chosen by artificial [14].

Furthermore, in the algorithm, instead of using the form of general detection methods, simulations and experiments have verified the system to be efficient [15-17].

ACKNOWLEDGMENTS

This work is supported by Natural Science Foundation of Hubei Province (No. 2012FFB00604) and National Natural Science Foundation of China (No. 51174084).

REFERENCES

[1] KuritaT and Hattori M, "Development of New-concept Desk Top Size Machine Tool . International Journal of Machine",Tools&Manufacture Design Research and Application, June, 2005, pp. 959-965.

[2] Bennett, MarylynH and TobinJr, "Automatic Defect Classification: Status and Industry Trends ", Proceedings of SPIE-The International Society for Optical Engneering, 2002,pp. 46-53.

[3] E. S. Ibrahim, "Electromagnetic Fault Current Limiter", Electric Power System Research, Vol. 42, 1997, pp. 189-190.

[4] Pospiech and F. Olsen, S. "Embedded Software in the Soc World: How Hds Helps to Face The HW and SW Design Challenge", IEEE Transactions on Custom Integrated Circuits, March 2003, pp.653-658

[5] Mao Lin, "Research on Image Matching on Improvement Curve Fourier Transformation", Computer Simulation, Vol 6, no.10, 2011, pp. 265-268.

[6] Cerra J M, "Medical Voice Recognition Software and the Electronic Medical Record". Delaware Medical Journal, Vol 5, no.73, 2011, pp. 291-295.

[7] F Fekri, "Filter Design and Theory - Two-Band Wavelets and Filterbanks Over Finite Fields with FConnections to Error Control Coding", IEEE Transactions on Signal Processing, July,2005, pp.354-360.

[8] Brink AD, "Threshold of Digital Image Using Two-dimensional Entropies", Pattern Recognition, Vol 8, no.10, 1992, pp. 80-83.

[9] Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara, and S. C. Mukhopadhyay, "Towards the

Implementation of IoT for Environmental Condition Monitoring in Homes" IEEE SENSORS JOURNAL, VOL. 13, NO. 10, OCTOBER 2013, pp. 3846-3853.

[10] Y.R.Shiau and B.C.Jiang. “Study of a measurement algorithm and the measurement In machine metrology”, Advanced Manufacturing Systems, July 1999,pp.22-34

[11] Du-Ming Tsai and Tse-Yun Huang. “Automated surface inspection for statistical textures”, Image and Vision Computing, June 2003, pp.307-323

[12] Shuyin Yang, “Program Design on VC++ Image Processing”, Beijing: Tsinghua University Press, 2005, pp.264-267.

[13] M.Iwahara, S.C.Mukhopadhyay, S.Yamada and F.P.Dawson, "Development of Passive Fault Current Limiter in Parallel Biasing Mode", IEEE Transactions on Magnetics, Vol. 35, No. 5, pp 3523-3525, September 1999.

[14] I. I. Aleshin, “New Semiautomatic Instrument for Testing the Accumulated Error of Circular Pitches in Spur Gears”, Measurement Techniques, Vol 12, no.9, 1997, pp. 621-630.

[15] S. Yamada, K. Chomsuwan, S.C.Mukhopadhyay, M.Iwahara, M. Kakikawa and I. Nagano, “Detection of Magnetic Fluid Volume Density with a GMR Sensor”, Journal of Magnetics Society of Japan, Vol. 31, No. 2, pp. 44-47, 2007.

[16] S.N.Talukdar, J. Apt, M.Ilic, L.B.Lave and M.G.Morgan, “Cascading Failures: Survival versus Prevention”, The Electricity Journal, Elsevier Inc, November 2003, pp. 25-28.

[17] Otsu N, “Determinant and Least Square Threshold Selection”, In: Procss, 1978, pp.592-596.