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Multivariate Positioning and Dimension Measurement Technology Based on Template Matching

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Abstract. In the process of semiconductor chip packaging, to solve the problem of multiple positioning and precise size measurement, this paper proposes a visual positioning and measurement technology based on template matching. Firstly, the identification points are obtained from the calibration plate and the internal and external parameters of the camera calibration are calculated. Then, based on the comparative analysis of different template-matching and positioning technologies, the shape-based template-matching method is adopted to quickly match the shape model of the best target chip, and the pyramid layered search strategy is applied to realize the online real-time positioning and identification of the chip under different lighting conditions. Finally, the gauss fitting sub-pixel edge detection method was designed to obtain the sub-pixel edge contour of the target chip, and the precise measurement of pin spacing and external dimension of the chip was realized. Experiments show that the detection system can realize accurate identification of different kinds of target chips under complex conditions such as occlusion and stack, and has low requirements for lighting environment. It can satisfy real-time and accurate positioning and measurement of multiple chips, and the actual measurement error of the system can reach 0.16%.

Keywords: edge detection, IC chip inspection, machine vision, template matching, visual detection system

1 Introduction

In the modern large-scale production, with the rapid development of integrated circuit manufacturing industry, surface mount technology has become a pillar technology in the electronic manufacturing industry, chip packaging is the fundamental to ensure the performance of integrated circuit, so the accurate positioning and size detection of mount chip is very important. In the 1990s in order to improve the mounting accuracy of the chip, specially installed a mechanical centering table, so that it has the advantages of high flexibility, many functions [1]. However, the purely mechanical grasping head and centering table weaken the centering precision of the equipment and cause damage to the pins of the fine mounting element. Traditional measurement methods cannot meet the needs of the growing industrial field, so it is necessary to use non-contact nondestructive testing, machine vision testing to achieve accurate positioning and measurement of the chip. Developed at the end of the 20th century, the machine vision technology, in the visual identification and positioning of the image processing, using interpolation method to improve sub pixel location accuracy and similarity matching, and similarity detection algorithm and its improved algorithm, and then choose a suitable algorithm according to the different component, can not only shorten the image processing time, and can satisfy the precision requirement of chip SMT [2]. This measurement method requires almost no manual participation, and the whole measurement process is automated. It has the characteristics of objectivity, high efficiency, high

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accuracy and no damage to the chip components, which improves the efficiency of the chip measurement and ensures the safety and reliability of the work.

Although machine vision detection develops rapidly, its application is susceptible to environmental changes, such as illumination and temperature [3]. In addition, image processing has a large amount of data, so the processing effect of multiple chip stacks and simultaneous recognition of different kinds of chips is poor. Therefore, this paper carries out in-depth theoretical and experimental analysis on chip multi-location and dimension measurement based on template matching.

In this paper, on the constructed hardware experiment platform, the transformation between physical coordinate system and pixel coordinate system is realized through camera calibration, and the template matching based on shape is studied in depth. Template matching is carried out according to the contour shape features of the template, such as corners, radians, points and regions. In this method, only important feature information in the image is retained, unnecessary information is removed, and computation is greatly reduced. Moreover, according to the creation of chip templates of different types, the simultaneous positioning and identification of multiple types of chips can be realized. In the dimension detection of the chip, the gauss fitting sub-pixel edge detection method is introduced to further improve the measurement accuracy, and efficiently and stably realize the location identification and dimension detection of multiple kinds of chips.

2 Measurement System

Visual measurement is an extremely important branch of machine vision in the field of industrial detection [4]. Visual detection is to use the industrial camera to achieve the function of image acquisition, image processing system (computer operating system, application software, image processing algorithm software, etc.) for image processing, to achieve the feature extraction of the measurement target, the corresponding algorithm programming. Then the processing results are output by the display unit, and finally the field equipment operation is controlled according to the obtained results [5].

The visual measurement system in this paper is shown in Fig. 1. It's hardware system of the measurement system is to achieve chip image acquisition by means of bracket, backlight source and 5-megapixel CCD black and white camera. The digital processing and display of the collected pictures are completed by the computer.

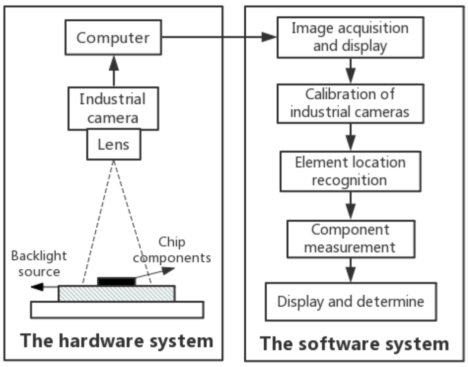


Fig. 1. The composition diagram of the visual measurement system, the left is the hardware system composition diagram; the right is the software system flow chart

The software system mainly completes the core algorithm of visual detection system through Halcon programming software. Firstly, the intrinsic and external parameters of the camera are calculated to achieve camera calibration. Then the ROI area of the target template is obtained, and the best model can be quickly matched through the shape-based template matching. Image pyramid hierarchical search strategy is adopted to realize real-time multivariate positioning. Interception location to the target area, after the whole line and whole at the center of the image distance rectangular column (in rectangular coordinate system) of subpixel location for sampling, the bilinear interpolation algorithm, after preliminary acquisition chip edge profile, the outline and the standard deviation of the Gaussian smoothing nuclear derivative convolution, calculate the sub pixel edge location, as the final measurement results show. The specific program flow is shown in Fig 2.

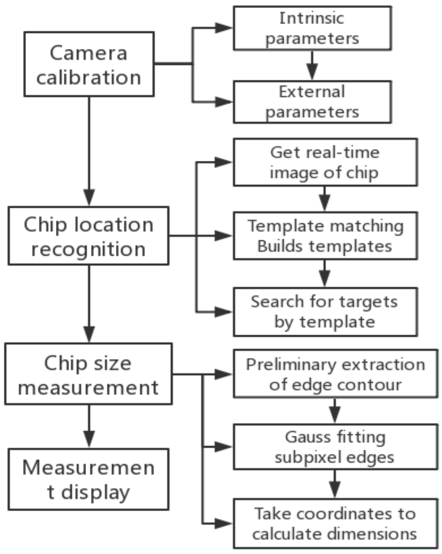


Fig. 2. Software system flow chart, describes the system software programming process

3 Measurement System Design

3.1 Camera Calibration System

In image measurement process and machine vision applications, in order to determine the three-dimensional geometry of space objects surface, with some points with the interrelation between the corresponding points in the image, it is necessary to establish the camera imaging geometric model, which can be calculated by the size of the objects in the image. The size of the actual object and the geometric model parameters is camera [6]. Under most conditions, these parameters must be obtained through experiments and calculations. The process of solving these parameters is called camera calibration. The process of camera calibration is to determine the intrinsic parameters (principal distance, distortion, scale factor, main point, etc.) and external parameters (the relationship between the camera coordinate system and the world coordinate system) [7].

Whether in the application of image measurement or machine vision, the calibration of camera parameters is a very critical link, and the accuracy of the calibration results and the stability of the algorithm directly affect the accuracy of the results produced by camera work [8]. Therefore, good camera calibration is the premise of follow-up work, and to improve the precision of calibration is the focus of scientific research.

In order to determine the intrinsic and external parameters of the camera, it is necessary to find the relationship between the camera coordinate system and the world coordinate system. The transformation from the world coordinate system to the camera coordinate system is a rigid transformation. Take a point $P_w= (X_w, Y_w, Z_w)^T$ in the world coordinate system, corresponding to $P_c= (X_c, Y_c, Z_c)^T$ in the camera coordinate system, then the relation between the two points is:

$$P_c = R \times P_w + T. \tag{1}$$

In the formula, $T = (T_x, T_y, T_z)$, $R = (\alpha, \beta, \gamma)$, the six variables are the external parameters of the camera and determine the relative position between the camera coordinate system and the world coordinate system.

Intrinsic camera parameters (f, k, S_x, S_y, C_x, C_y) determine the projection of 3d spatial points in the camera coordinate system to 2d images. If the lens does not distort P_c, the coordinate projected to the image coordinate system is (u, v), and the relationship between them is:

$$\begin{pmatrix} u \\ v \end{pmatrix} = \frac{f}{z_c} \begin{pmatrix} X_c \\ Y_c \end{pmatrix}. \tag{2}$$

f represents the focal length and Z_c represents the distance from the target object to the camera. The lens distortion causes the coordinate (u, v) to change, and the lens distortion commonly used in computer vision application is the radial distortion.

$$\begin{pmatrix} u' \\ v' \end{pmatrix} = \frac{2}{1+\sqrt{1-4k(u^2+v^2)}} \begin{pmatrix} u \\ v \end{pmatrix}. \quad \textbf{(3)}$$

k represents the radial distortion order of the lens, and u', v' represents the offset projection point coordinates on the imaging plane obtained due to the lens distortion. The projection point on the imaging plane is converted into the image coordinate system.

$$\begin{pmatrix} u' \\ v' \end{pmatrix} = \begin{bmatrix} \frac{v'}{s_y} + C_y \\ \frac{u'}{s_x} + C_x \end{bmatrix}. \quad \textbf{(4)}$$

In the above formula, S_x and S_y are scaling factors. For pinhole camera, they represent the distance between adjacent pixels in horizontal and vertical directions on the image sensor. Point (C_x, C_y) is the main point of the image, which is the vertical projection of the projection center on the imaging plane [9]. By using the mapping, the image distortion operator can be eliminated, and then the corresponding relationship between the point P_w in the world coordinate system and the point in the image can be obtained.

According to the above calibration principle, in order to carry out camera calibration, it is necessary to know enough coordinates of 3d space points in the world coordinate system, find the corresponding coordinates in the image, establish the corresponding relationship, and then obtain the internal and external parameters of the camera. Plane calibration board is the most commonly used calibration tool, which is easy to operate, accurate and suitable for backlight lighting applications [10].

This system uses Halcon to complete the single target determination of the camera. The polka-dot calibration board of 60mm×60mm is adopted. In the calibration process, the handle of the calibration template is first set to obtain the calibration region of the image. Then, the center coordinates of the identified points and the initial pose of the calibration plate are obtained. The coordinates of the target point read are compared with the description file. In combination with the external parameters of the camera, the handle of the camera calibration template is constantly modified. Finally, the external parameters of the camera are obtained through the position of the calibration board. Fig. 3 shows part of the calibration board images taken.

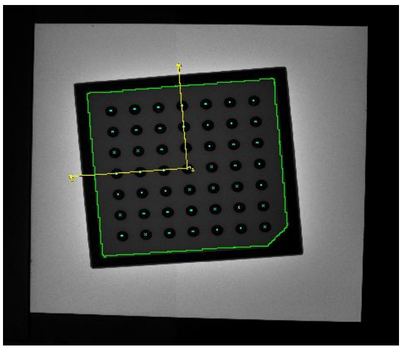


Fig. 3. The calibration board collects images

The number of calibration board images is the main factor affecting the accuracy of camera parameters. This system takes 15 images of the calibration board at different positions (the calibration board rotates around the x and y axes or places the calibration board at different distances from the camera). In the calibration process, attention should be paid to the contrast of the image. In addition, it is also necessary to pay attention to whether the marking points are clearly imprinted, whether the central coordinates of the marking points can be accurately obtained, whether the calibration illumination is uniform, and whether the field of vision is completely covered by the calibration plate. When each calibration image meets the above calibration conditions and there is no quality problem, it can be saved as the output of the calibration image to complete the calibration. The final calibration parameters are shown in Table 1.

Table 1. Calibration parameter value includes the specific calibration value of the camera's intrinsic and external parameters

Camera intrinsic parameters		Camera external parameters	
width of a single pixel (S_x)	3.44674μm	X(T_x)	14.817mm
height of a single pixel (S_y)	3.45μm	Y(T_y)	11.8846mm
focal length (f)	9.684mm	Z(T_z)	258.814mm
Kappa (k)	-1872.95/1/m²	Rotate X(α)	0.97774°
x-coordinate of the center (C_x)	1244.83 pixel	Rotate Y(β)	3.45098°
y-coordinate of the center (C_y)	1028.63 pixel	Rotate Z(γ)	3.00913°
Image width	2448 pixel	/	/
Imageheight	2048 pixel	/	/
Average error	0.0175969 pixel		

3.2 Location Recognition of Multiple Kinds of Chips

In the detection system of machine vision, it is the core of the detection system to accurately and efficiently locate the direction and position of the target product. Template matching is one of the simplest, direct and most widely used localization and recognition methods. It studies the position of the pattern of a specific object in the image and realizes the localization and recognition of the target object [11]. The object of this system is IC chip. Through the analysis of chip shape characteristics, the chip is identified and classified according to the similarity criterion of template matching. Template matching is divided into two steps: one is to develop a standard template according to the regional gray feature or contour feature of the chip, the second is to search the target chip with the same feature through the generated standard template [12]. By matching the template of target chip features, the vision positioning system realizes the real-time accurate positioning and identification of multi-chip.

The system collects real-time images of different kinds of chips through the camera, and transmits the image data to the image processing system. The image processing system matches and searches each image according to the standard template created, and accurately locates the number, position and direction of the target chip.

The core idea of template matching is to realize chip location recognition by creating templates. Template matching is generally divided into three categories: template matching based on gray value, template matching based on correlation, and template matching based on shape.

External environmental factors have a certain impact on the creation and search of templates. For example, under different lighting environments, the grayscale value of light and dark background is different, which can only be accurately recognized in a small range of grayscale. Obstacle occlusion within the field of vision and stacked coverage of multiple chips will affect the accuracy of search results, and the obstacles may be used as the target chip identification output or miss the target chip partially occluded within the field of vision [13].

Considering the above environmental factors and the reasonableness of template establishment, this paper finally selects template matching based on shape to realize multiple recognition and positioning of chip. According to the establishment of the shape contour template, the image matching and recognition algorithm based on the shape template is realized. First, the ROI area of the shape template is obtained, and then the pixel coordinates of the target template are normalized. The mathematical formula is as follows:

$$\delta(x,y)=\frac{\sum_{i=-\frac{m}{2}}^{\frac{m}{2}}\sum_{j=-\frac{n}{2}}^{\frac{n}{2}} f(x+i,y+j)\cdot t(i,j)-m\cdot n\cdot\mu_f\cdot\mu_t}{\sqrt{\sum_{i=-\frac{m}{2}}^{\frac{m}{2}}\sum_{j=-\frac{n}{2}}^{\frac{n}{2}} f^2(x+i,y+j)-m\cdot n\cdot\mu_f^{\,2}}}\cdot\frac{1}{\sqrt{\sum_{i=-\frac{m}{2}}^{\frac{m}{2}}\sum_{j=-\frac{n}{2}}^{\frac{n}{2}} t^2(i,j)-m\cdot n\cdot\mu_t^{\,2}}}. \quad \textbf{(5)}$$

All pixels $(x, y) \in M \times N$
Among them:

$$\mu_f(x, y) = \frac{1}{mn} \cdot \sum_{i=-\frac{m}{2}}^{\frac{m}{2}} \sum_{j=-\frac{n}{2}}^{\frac{n}{2}} f(x+i, y+j). \quad \textbf{(6)}$$

$$\mu_t(x, y) = \frac{1}{mn} \cdot \sum_{i=-\frac{m}{2}}^{\frac{m}{2}} \sum_{j=-\frac{n}{2}}^{\frac{n}{2}} t(i, j). \quad \textbf{(7)}$$

$M \times N$ represents the size of the window, so the computational complexity is $O(M \times N \times M \times N)$. It can be seen from the above formula that the mean value and the sum of squares can be estimated by the integral diagram. For the application scenarios where the size of the template and the target image are the same, the target template is then obtained.

After the template is created, the image matching search is started. In this paper, the image pyramid hierarchical search strategy is adopted to realize the online real-time location and recognition of the target chip.

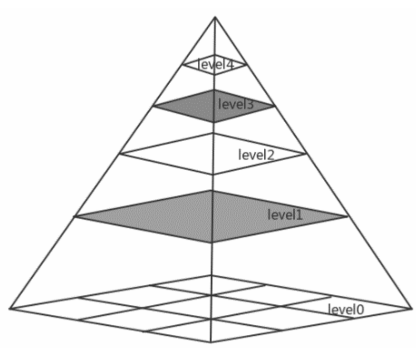


Fig. 4. Image pyramid structure schematic diagram. The image series are layered in a pyramid structure with a gradually reduced resolution

Image pyramid is an effective but conceptually simple structure that interprets images in multiple resolutions (as shown in Fig. 4) for image segmentation, machine vision and image compression. The pyramid of an image is a collection of images from the same original image that are progressively reduced in resolution in the form of a pyramid. It is obtained by cascade downward sampling until a certain termination condition is reached [14]. The bottom of the pyramid is a high-resolution representation of the image to be processed, while the top is a low-resolution approximation. The image layer by layer is compared to a pyramid. The higher the level, the smaller the image and the lower the resolution.

The model created in this article is generated using multiple image pyramid layers and stored in memory. Firstly, the similarity measurement matching search is carried out on the top layer of the image pyramid, and the potential matching points, matching scores and transformation parameters are returned, and the template is transformed accordingly [15]. Then, according to the size of the matching points of these potential matching points, the potential matching points are tracked to the position of the potential matching points at the lower layer of the image pyramid, and the transformed template is matched to the search image in the 5×5 neighborhood of the potential matching points, and the potential matching points and their transformation parameters are returned, so on until the bottom of the pyramid image matching end.

3.3 Chip Size Measurement

After the target chip is located and identified, the size detection system needs to realize the accurate measurement of chip size. It is the latest application trend of machine vision to use the edge contour of the chip to obtain the coordinate value of the edge point to measure and calculate the chip size [16]. The image sensor can display the object on the plane and measure the position, width and angle by edge detection. Edge refers to the area where the bright part and the dark part of the image intersect and transit. Edge detection is to detect the straight line formed by the points with varying shades through the visual system [17].

The system first obtains the target chip's edge contour preliminarily through interpolation algorithm, then creates the measurement rectangle, averages the gray value in the "slice" perpendicular to the rectangular spindle, convolutes the contour with the derivative of the Gaussian smooth kernel of the standard deviation, and further obtains the image's sub-pixel edge.

Because the edge contour obtained by interpolation algorithm has fuzzy effect, the edge shape is not uniform, so it is not suitable to measure and calculate directly. Therefore, further Gaussian model fitting will improve the measurement accuracy and be more suitable for the actual situation of edge extraction.

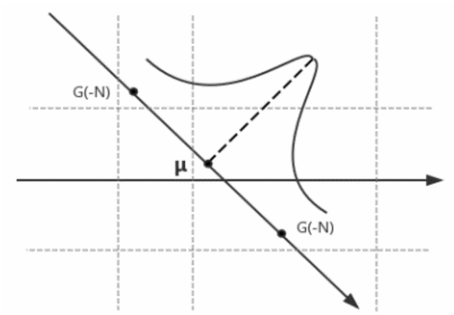


Fig. 5. Subpixel edge extraction based on Gaussian fitting

As shown in Fig. 5, the dotted line grid represents the integer pixel points in the image. Let G be the gradient function, and the origin of the coordinate system coincides with the edge contour points. In the gradient direction, the algorithm obtains $2N+1$ sampling points $G(-n)$ by interpolation. $G(0)$ ... $G(+N)$. Then the $2N+1$ sampling point are used to fit the one-dimensional Gaussian function, and the position of the center point of the Gaussian function obtained is the updated sub-pixel edge point coordinates [18].

Specifically, the fitted Gaussian function is:

$$\kappa_{\sigma,\mu,k}(x) = k\frac{1}{\sqrt{2\pi\sigma^2}}\exp-\frac{(x-\mu)^2}{\sigma^2}. \quad \textbf{(8)}$$

Where: μ is the sub-pixel edge coordinate, σ is the standard deviation of the Gaussian function, k is the magnitude of the Gaussian.

In the fitting process, the least square method is used to solve the μ 、σ 、κ parameter values of the gaussian function. The objective function is the mean square error between the gradient point $G(i)$ and the Gaussian function prediction point $N(i)$:

$$S = \frac{1}{2N+1}\sum_{i=-N}^{n}(G(i)-\kappa(i))^2. \quad \textbf{(9)}$$

The algorithm usesLevenberg-Marquardt method to solve the above optimization problem. The initial value of the fitting parameter is set to k= *Max* $\{G(I)\}$, $\sigma = 2N+1$, μ =0.

4 Analysis of Result

4.1 Chip Template Matching Results

In this paper, three template matching methods(template matching based on gray value, template matching based on correlation, and template matching based on shape) are respectively verified by experiments, and the results of three different methods under different environmental factors are compared.

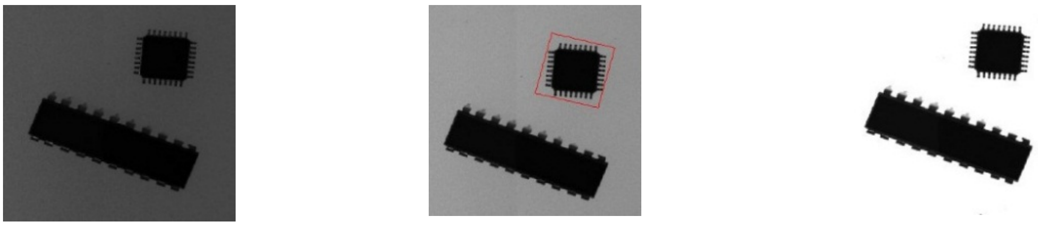
4.1.1 Comparison of Recognition Results of Three Matching Methods under Different Illumination Environments

The first set of experiments was based on three matching methods with different lighting factors. The matching template is created through the graph collected in real time, as shown in Fig. 6 (the following IC chip positioning is the template).

(a) IC chip template (b) Extrapolation chip template

Fig. 6. Template matching chip template image

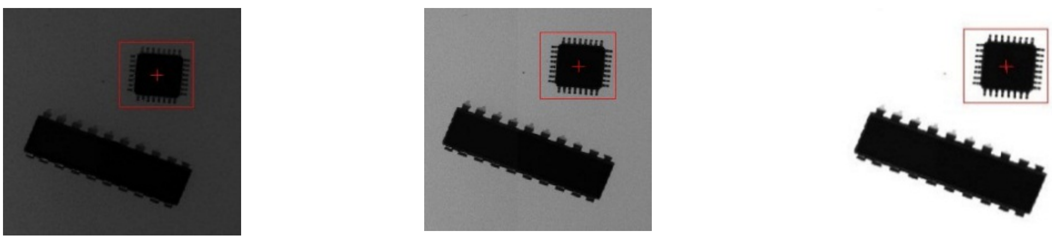
Gray scale template matching is a search matching based on the similarity between the template and the grayscale value of the target chip in the image collected in real time. Because the search basis of this method is similar to the grayscale value, it is highly affected by illumination, and the target chip cannot be searched under the illumination with a large difference from the template. As shown in Fig. 7(a), Fig. 7(b) and Fig. 7(c), respectively the matching results of this method under different lighting factors, it can be clearly found that only the target chip under normal lighting environment similar to the template can realize positioning recognition(the target chip is identified when the red box area is marked), and the target chip cannot be recognized under weak light and strong light.



(a) Weak light environment (b) Normal light environment (c) Strong light environment

Fig. 7. Template matching effect of different illumination factors under grayscale template

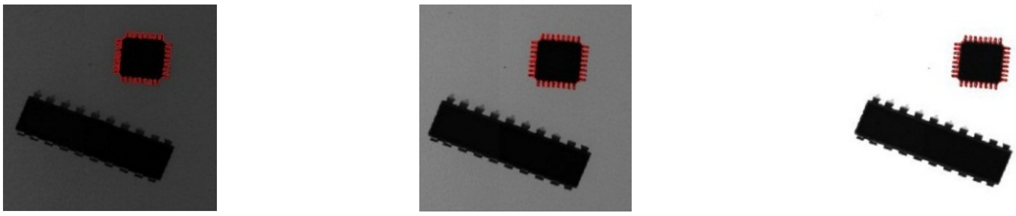
Correlation based template matching is a search and matching based on the correlation between the region template and the region of the target chip in the real-time acquisition image. The NCC algorithm can effectively reduce the impact of illumination on the image comparison result, so it can meet the target chip positioning under different lighting environments. The experimental results are shown in Fig. 8(a), Fig. 8(b), Fig. 8(c). It can be clearly found that the positioning and recognition of the chip can be realized when the gray values of weak light, strong light and natural light vary greatly.



(a) Weak light environment (b) Normal light environment (c) Strong light environment

Fig. 8. Template matching effect of different illumination factors under correlation template

The shape of template matching is based on the actual shape of template and real-time graphics chips for template matching. To create a shape template, obtain the chip shape outline; take image pyramid hierarchical search strategy, in the search process of direct search target chip shape outline, accurate identification to the target chip, high matching precision. The experimental results are shown in Fig. 9(a), Fig. 9(b) and Fig. 9(c). Since the shape and contour of the outer edge of the chip are searched directly in the search process, it is not necessary to consider the factors of external lighting environment, which can satisfy the positioning and recognition of the chip under various lighting environments. The outline of the red area in the figure below is the positioning result of the target chip identified through shape matching.



(a) Weak light environment (b) Normal light environment (c) Strong light environment

Fig. 9. Template matching effect of different illumination factors under shape template

Based on the above experimental results, it can be concluded that the template matching based on gray level can only realize chip positioning and recognition in a small gray level range due to the high requirements for the lighting environment, so this method has great limitations and is not adopted.

4.1.2 Comparison of Correlation Template Matching and Shape Template Matching

A second set of experiments comparing the results based on the contours is identified by the location. The experiment mainly verifies the difference of location recognition effect between correlation template matching and shape-based template matching.

In the experiment, two different methods were used to locate and identify the target chip under the same illumination environment and the same placement of the target chip. Fig. 10(a) is the template matching based on correlation. This method creates the template based on the region block. In the search process, the correlation between the real-time image collection and the region block template is normalized, and five chips are found. Fig. 10(b) shows the shape-based template matching. This method directly creates the template based on the shape contour of the target chip. In the search process, pyramid hierarchical search strategy is adopted to search the target chip based on the created shape contour, and six chips are found.

(a) Correlation template matching (b) Shape template matching

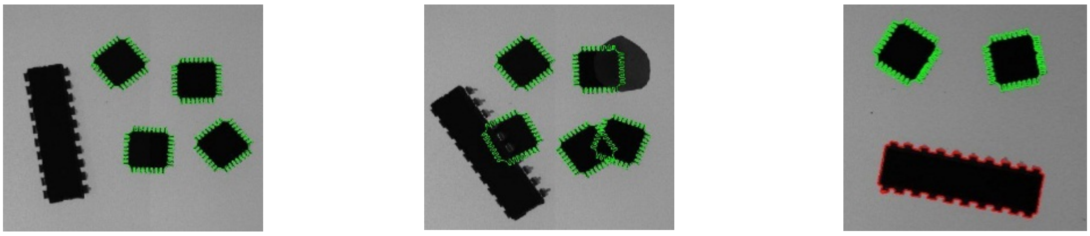
Fig. 10. Template matching results under the same environmental factors

In exactly the same lighting conditions and the use of chip placement by Fig. 10(a) and Fig. 10(b) contrast analysis, based on the correlation of template matching in finding target chips, joint area of the background will also find together, can reduce the search accuracy and positioning accuracy, can appear for target chip stack and cannot locate the problem, thus have to chip in the graph search failure. Shape-based template matching can accurately identify all target chips in the case of chip stacking because it can directly search the shape and contour of target chips with high accuracy.

According to the above experimental results, the shape-based template matching is of higher accuracy, which can realize the positioning identification of various chips and accurately locate the chip contour. Therefore, shape-based template matching is the most suitable positioning method for the measurement system in this paper.

4.1.3 Comprehensive Recognition Results of Shape Template Matching

The third group of experiments on the shape - based template matching location recognition is for comprehensive experimental analysis. When other kinds of chips appear at the same time, all the target chips within the field of vision can be accurately identified, as shown in Fig. 11(a). When obstacles and chips are stacked at the same time, the positioning and identification of the chip can accurately identify all the target chips in the field of vision, as shown in Fig. 11(b). When two different types of chips need to be identified at the same time, the contour of the green area is the output of the result identified to the IC chip, and the contour of the red area is the output of the result identified to the plug-in chip, as shown in Fig. 11(c).



(a) Normal environment (b) Obstruction stack (c) Multispecies identification

Fig. 11. Matching results of shape templates in different environments

Finally, it is concluded that the shape - based template matching is the best one, which can satisfy various chip location recognition under various environmental factors.

4.2 Chip Size Measurement Results

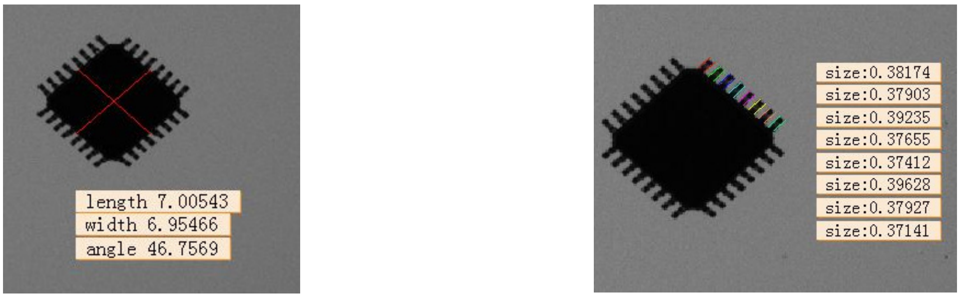
The measuring system in this paper firstly obtains the edge of the target chip preliminarily through interpolation algorithm, and then carries out Gaussian fitting on the acquired edge contour, and further obtains the sub-pixel edge of the image, so as to achieve the purpose of accurate measurement.

As shown in Fig. 12(a), the edge of the chip pin(the outline of the red region) obtained by the interpolation algorithm is rough, and the shape of the edge changes greatly, so the accurate measurement of the chip pin spacing cannot be realized, and the direct measurement error is large. Therefore, it is necessary to carry out Gaussian fitting on the initial acquired edge contour to further obtain the sub-pixel edge of the image. Create perpendicular to the chip pins and measurement of each side of the rectangle (Fig. 12(b) blue line for measuring the center of the rectangular axis), select the rectangular axis direction transition from dark to bright side of the side, by the excessive negative and dark lights, extract the edge of the perpendicular to the single point on the rectangular axis returned, as shown in Fig. 12(b). The chip pin spacing Gaussian fitting is after edge detection result, the green line profile is measured by the edge of the rectangle fitting to the chip pins, thus can be clear when Gaussian fitting the edge effect is better. The coordinate value difference of each chip pin is calculated by the obtained intersecting point coordinate value between the edge and the central axis, which is the final chip pin spacing.

(a) Preliminary extraction of edge contour (b) Gauss fitting sub pixel edges

Fig. 12. Chip pin edge contour extraction

In terms of chip size, measurement rectangles are established respectively through the direction of length and width, so as to obtain the value of chip length and width, and the Angle value of the target chip from the horizontal axis according to the geometric relationship. The final chip sizes are shown in Fig. 13(a), Fig. 13(b).



(a) Measurement result of chip dimension (b) Measurement result of chip pin size

Fig. 13. Chip size measurement results

The size parameters obtained by sub-pixel edge extraction have been introduced into the system calibration of camera internal and external parameters in the programming process. The final value is the actual measured size of the chip. The following is the error analysis of the measurement results shown in Table 2.

Table 2. Through ten sets of measurements analyse system stability and measurement error

	Dimensional measurement result	
serial number	length/mm	width/mm
trim size	6.98	6.92
1	7.00114	6.93338
2	6.97121	6.92113
3	6.96311	6.91416
4	7.00721	6.93882
5	6.98519	6.92281
6	6.98021	6.93169
7	7.00204	6.92409
8	6.97639	6.93884
9	6.97975	6.91226
10	6.98666	6.92504
variance	0.000204	0.000087
measuring error	0.0016044	0.0012916

The measured data in Table 2 show that the mean value of the measured results is close to the size value actually measured by the chip, and the variance and standard deviation are small, indicating that the system works stably. Finally, the measurement accuracy of the measurement result is calculated from the ten groups of measurement data in the table. It can be seen that the actual measurement error of the system can reach about 0.16%, and the measurement accuracy is high, which can accurately detect the size of the chip.

5 Conclusion

In this paper, the SMT chip visual positioning and size detection technology conducted in-depth research, mainly studies the chip positioning identification technique based on template matching, fast matching chip best shape model, taking the image pyramid hierarchical search strategy, based on grey characteristics, the correlation feature and shape feature of template matching for the comparison and analysis of theory and experiment. It is proved by experience that template matching based on shape, template is created according to shape profile of target chip, sensitivity to light change is weakened, and target chip can still be accurately located when obstacles are stacked and multiple chips are detected at the same time. In dimension detection, after the edge contour of the target chip is initially obtained by linear interpolation algorithm, Gaussian template is called to further fit the edge contour and obtain the sub-pixel edge, so as to realize the dimension detection of the chip.

Based on the study found that when the template matching method based on the shape of the anti-jamming performance is good, but on the algorithm, the target template threshold and parameter setting of adaptation ability is poor, only for a scenario of an object, the introduction of a new type of chip need to create a template, further research should be combined with the adaptive threshold algorithm for optimization.

Practical industrial application environment is very complex, the proposed the size of the chip positioning recognition and high precision detection need to meet a good production environment, deep learning algorithms currently have certain superiority in the aspect of image locating and segmentation, follow-up study deep learning method can be used for different kinds of chip segmentation and matching, solve a variety of scenarios visual positioning and the problems existing in the testing of the chip.

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