Application of defect detection in gluing line using shape-based matching approach

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ABSTRACT – This paper investigates various approaches for automated inspection of gluing process using shape-based matching application. A new supervised defect detection approach to detect gap defect, bumper defect and bubble defect in gluing application is proposed. The creation of region of interest for important region of the object is further explained. The Correlation algorithm to determine better image processing result using template matching techniques is also proposed. This technique does not only reduce execution time, but also produce high accuracy in defect detection rate. The recognition efficiency will achieve more than 95% with defect's data for further process.

1. INTRODUCTION

Vision-based inspection of industrial products offers low-cost, high-speed, and high-quality detection of defects. One of the most challenging industrial inspection problems is dealing with the textured of the gluing process. Defects often happen during gluing process. To ensure that only quality units are produced, defects detection and recognition system commonly are installed for segregation of the defects unit. There are many techniques that provide a solution in recognizing image or object in image processing such as region [1], edge-based features [2], feature extraction [3], shape context [4], Gaussian Curve [5] and etc. Other researches were based on HALCON Application for Shape-Based Matching [6-8]. The researches discussed about the process involved in basic shape based matching algorithm together with Extended Region of Interest (ROI) function available in HALCON that fulfils shape based matching to find object based on a single model image with sub pixel accuracy. The basic concept of defect matching using shape-based matching algorithm based on Extended Region of Interest introduced by [9].

In this paper, an improve filter method that uses a computer to automatically recognize the gluing defects is put forward. In this approach, the digital image of the gluing defects is binarized first. Then ROI is further process before. Correlation algorithm refines the image. Once the importance feature of the binarized image has been extracted, the features are trained for defect classification. To better understand this method, in the next section, each kind of defects is elaborated further.

ROI is applied to reduce processing time. Then depending on the features classification of the defect, feature extraction and Gaussian smoothing are used.

2. METHODOLOGY

Shape-based matching application is divided into two phases, Training phase and Recognition phase as shown in figure 1. Training phase is important in identifying the defect correctly. If the usage of the specific data are not optimize, the result will not be as accurate as what we desired. Hence, defect matching results with high accuracy and precision depends on the best reference image transformation. Matching phase is used to find similarity between reference images and tested images. Similarity is classified as recognition rate. Higher recognition rate means the systems proposed are effective and optimize. This application is easier to process because it reduce the region known as Region of Interest chosen by the users. Processing time can also reduce apart from producing higher recognition rate.
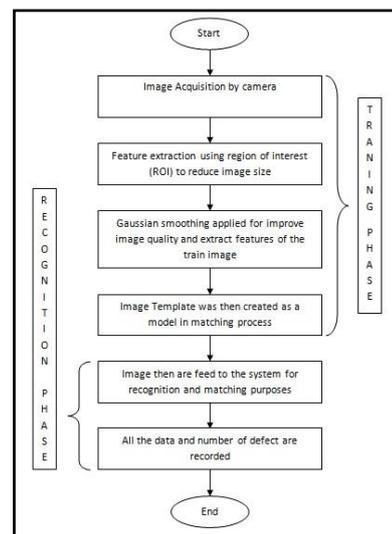

Figure 1 Proposed Vision Algorithm

Correlation is a measure of the degree to which two variables (pixel values in template and source images) agree, not necessary in actual value but in general behaviour. In correlation method, results of combination of differences between template gray level image, x_i with average gray level in the template image, $\dot{x}$ and difference between source image sections, y_i with

the average gray level of source image, ẏ are compared to the square root summation of the pixel differences between two images. Correlation value is between -1 and +1, with larger values representing a stronger relationship between the two images. Figure 2 and equation 1 shows the correlation relationship.
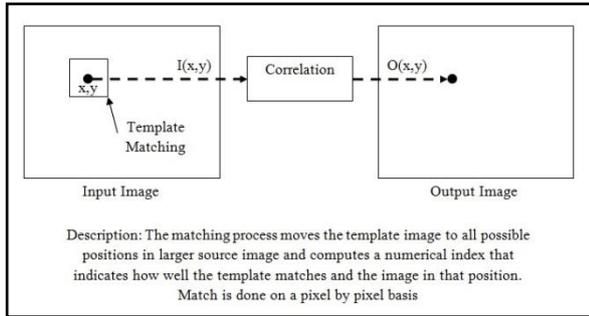

Figure 2 Template Matching Process Evaluation

$$cor = \frac{\sum_{i=0}^{N-1}(x_i - \dot{x}) \bullet (y_i - \dot{y})}{\sqrt{\sum_{i=0}^{N-1}(x_i - \dot{x})^2 \bullet \sum_{i=0}^{N-1}(y_i - \dot{y})^2}} \qquad (1)$$

Where N = template image size = column x row

Correlation value totally depends on template creation throughout the system. Without proper contribution on it, may result to poor recognition rate. The important of ROI extraction method that delivers the precise region helps in findings the same object from various types of images.

3. RESULTS AND DISCUSSION

The potential of the proposed visual algorithm system was the flexibility of the program to accommodate changes. 10 images are being tested repeatedly for 10 times for its flexibility in determining all defects occur in the tested images. The tested images are filled with all the three defects models that are already being trained in training phase and fed into the system for recognition purposes.

Table 1 Recognition Rate for Proposed Defect Inspection System

No. of Test	Total Defect	Defect Detected	Average Defect Detected (%)
1	72	69	95.83
2	72	68	94.44
3	72	67	93.06
4	72	70	97.22
5	72	68	94.44
6	72	69	95.83
7	72	67	93.06
8	72	68	94.44
9	72	69	95.83
10	72	70	97.22
Total	720	685	95.14

Table 1 shows the result of defect matching by using 10 tested. According to the results, the recognition rate of the experiment is about 95.14% based on 3 model defects created through the system. This result is compared with [10] where it considered the problem in

detecting welding defects in welding lines where the past researchers put an effort on more complex algorithm or limited in efficiency.

Table 2 Comparison of Results

	Weld Defect Detection	Glue Defect Detection (Proposed Method)
No. of Samples	500 samples	720 samples
No. of Types	6 types	3 types
Recognition Rate (%)	94.3%	95.14%
Error Rate (%)	5.7%	4.86%

4. CONCLUSIONS

Auto recognition of gluing defects is a useful research with strong application background. In this paper, a method that is used to extract features of defects and auto recognizes defects are put forward. Experimental results show that the recognition rate achieved about 95.14% which is much better for acquiring defect detection in gluing lines.

5. REFERENCES

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