The Deficiency Recognition in PCBA's Automatic Optical Inspection System by Using Back-Propagation Network Method

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Abstract: To improve the precision in the recognition process, a new algorithm (the image division method- IDM) is proposed. Recently, to meet various client requisitions, a flexible manufacturing process applied to various products of smaller quantity has become the trend. Even though the above new method can improve deficiency recognition in PCBA's, a huge quantity of samples used in off-line training is still obligatory. Unfortunately, the method is not suitable for a process that includes various products of smaller quantity. Moreover, not all deficiencies can be fully recognized by a single algorithm. To overcome the above drawbacks and increase the recognition rate, a combination of these algorithms in conjunction with a neural network system, which will increase the recognition rate with fewer samples, is proposed. Consequently, results reveal that deficiency recognition can be improved when the IDM in conjunction with other AOI algorithms are linked with a neural network.

Key words: Machine vision, back propagation neural network, image division method, AOI, PCBA, SMT

INTRODUCTION

The Printed Circuit Board Assembly (PCBA) is one of the most important components installed inside an electronic product. To promote electronic performance, many electronic elements have been installed onto the compact board; therefore, the Surface Mount Technology (SMT) used to fasten and assemble the Surface Mount Device (SMD) on the printed circuit board's surface becomes complicated. As expected, because of improper process, various deficiencies often occur. Therefore, quality control which can lower the cost of manufacturing is crucial.

The traditional inspection of PCBA is performed by humans and is time-consuming. This will result in fatigue. Therefore, the Automatic Optical Inspection (AOI), which lower labor costs while maintaining a higher inspection level, is widely used. To successfully identify the deficiencies inside a PCBA, the superiority of the inspection algorithm is important. To improve inspection efficiency with respect to various deficiencies, the AOI is equipped with different algorithms.

The white point statistic method is mainly used to identify the printed character as well as the related print. The image has classified as two values (black and white) by a threshold value which is determined by a specified region with contra colors. By summing up the total number of white points, the deficiency of the opposite element can be picked up. It is found that the white point statistic method is superior in identifying the deficiency of the opposite element due to the white color of the opposite surface element. However, precision will decrease when the ratios of the white point in the testing image are similar to those of the standard image (qualified image). Similarly, when a component is missing, the accuracy recognition will also decrease. To overcome this drawback, a manipulating selection of the image zone is required.

Yeh and Perng (2004) proposed the coefficient correlation method to recognize the deficiency in PCBA's images. By comparing the averaged gray value and variation between the standard image and the testing image, calculating their relationship and determining a threshold, the deficiency can then be distinguished. The coefficient correlation method is easy to use without presetting a threshold value; in addition, precision will not be influenced by various testing images. However, it will be highly influenced when the light intensity is changed or misalignment occurs.

A total gray error index method is calculated by subtracting all the gray values of the testing image with

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