



Review on PCB Defect Detection Using Image Processing

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Review on PCB Defect Detection Using Image Processing

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Abstract :

Automated PCB Defect detection is the way of detecting more accurate defect detection other than manual defect detection. It has a benefit relating to time degradation, precision detection. PCB Defect Detection Method is required to overcome some common defects that occurs normally during circuit operation. There are various PCB defect detection standards are used worldwide to assure that PCB can be worked properly in different temperature or not. The main contribution of this work lies in comparative study of different detection ways using Image Processing and their standards. This study will help to choose the affordable defect detection methods as per their requirements.

Keywords : PCB testing, MATLAB, Morphological method, Wavelet Transformation

Introduction

Image Processing is an Image based technique. It has so many features but the features that we use in this review paper is to identify difference between two images. Printed circuit board(PCB) is a base for any electronic circuits. Today, there are various techniques and in those techniques there are also different ways for PCB defect detection. In Image Processing Technique, we can use different algorithm or Mathematical approach.

PCB is a composite material of conductive and nonconductive layer. In that Copper is a conductive layer and FR4(epoxy resin), glass fibers are used as a non-conductive material[2].As per Increasing the usage of different electronics component and also regards to the safety of electronic gadgets at different environment, Electronic industry continues to update levels of integration to decrease defects. The Heart of any electronic component is their operational circuits and PCB is a crucial part of any operational circuits[1].In SMT type PCB, Defect detection is complicated than Bare PCB because of already mounted components on PCB.

The major defects are six types of any SMT(surface mount technology) PCB.

- 1)Open circuit
- 2)Short circuit
- 3)Mouse bite
- 4)Pinhole 5)Etching
- 6)Hole Missing

Background

Researchers have found that there are three main PCB defect detection approaches which is as follows 1)Referential based

2)Rule based

3)Hybrid approach

1)Referential based approach

It has Image comparison and Model based technique. In Image comparison, comparing two images' pixels by pixel using EX-OR operation. If two different image pixels have same parameters then It gives outputs as nothing and If two image pixels have different parameters then It gives output as true by focusing on defective part.

In Model based technique, it matches pattern and defining the output by using Run length Encoding technique[1].RLE technique is not just detect the defects but also detects the location of defect.

2)Rule based approach

It is a feature base method where It checks that each dimension is as per the requirement or not. It has used a morphological technique. Morphological techniques are classified in erosion, Dilation, Opening, Closing , Boundary extraction etc.

3)Hybrid approach

It is a combination of Referential based and Rule based approach. It increases the complexity and cost.

Methodology

Morphology is nothing but extracting image components that can be useful in representation and description of region shape such as boundaries, skeletal and convex null. Morphological Operations are used for automatic defect detection.

Image Segmentation : It is a process of partitioning a digital image into multiple regions and extracting the meaningful region which is known as Region of Interest(ROI)[3].

Image Subtraction and Addition : Image subtraction method is used for subtracting image which is not same as per the templet image or Rule based Image. It uses EXOR operation. Image Addition is used for adding two image or more image. It uses OR operation[3].

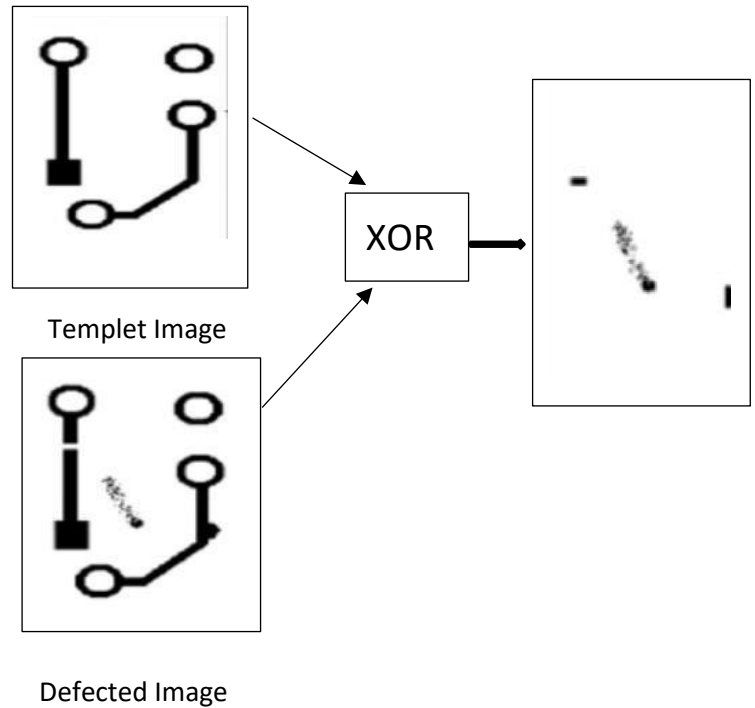
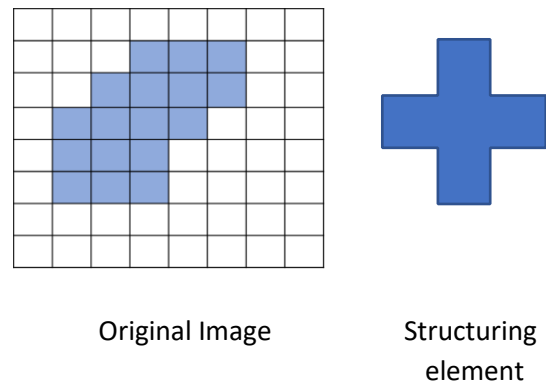
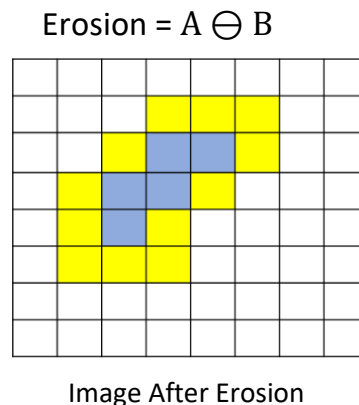


Figure 1 - Image Subtraction [4]



Erosion: It is used to reduce the number of pixels from the boundary. It shrinks an image. Pixels that will removed from image is depends upon structuring element.



Dilation: It adds the Pixels to the boundary of objects in an image or grow or thicken objects in a binary image. Pixels that will added in image is depends upon size and shape of structuring element. The structuring element which can hit by any one pixel is called dilation.

$$Dilation = A \oplus B$$

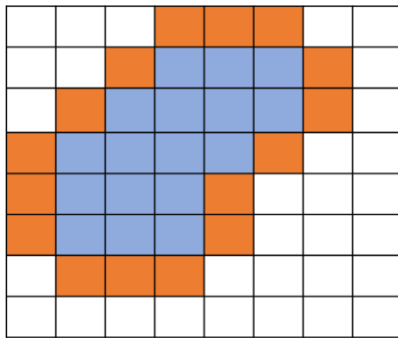


Image after Dilation

Opening : It connects tracks that have defects like burning or improper itching[1].It does not reduce the size as per erosion and dilation.

Closing : It detects the improper shorted path which is not useful now. It disconnects tracks that have shorted defects or unwanted connections.

Boundary Extraction : A Boundary of any reference image that can be eroded by another image and then performing the difference between reference image and its erosion is nothing but a boundary extraction. Suppose A is a reference image and that can be eroded by another image which is B and then the difference between Image A and its erosion. This process is failed sometime when we mounted PCB. Mounted PCB takes lots of time compare to bare PCB in Image Segmentation. It is because of lots of pixels.

Wavelet Transform : It is used to reduce size of the image specially when we are doing mounted PCB inspection. Aar wavelet

transform is used mostly to reduce size of the image. After reducing the size of an image, Image subtraction operation can be performed. Because of this wavelet transform, the selected algorithm is expected to detect more types of defects like breakout, short, wrong size holes, conductor too close, underetch, spurious copper, excessive short, missing conductor, spur and over-etch. It also reduces the process time[1].But the drawback is that when it performs compression the image, it is also neglected some important details of an image.

Thresholding : It will try to identify and extract a background of target image by the distribution of grey levels in image object. One dimensional thresholding technique is based on histogram grey levels and two dimensional is based on cooccurrence matrix of an image[1].

Histogram : It is a Graphical representation of any system. Histogram of an image represents the relative frequency of occurrence of various grey levels in an image. It is used for manipulating contrast or brightness of an image.

Conclusion

Automatic defect detection system is faster than the manual PCB defect detection. Image difference operation gives better result with wavelet transform. It reduces the detection time as well as complexity of targeted PCB image. By using some optimal approach. We have furnished a brief review of all possible technique to overcome defect detection time as well as to improve quality of captured PCB image.

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