PCB Defect Detection by Image Processing

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Abstract— A Printed Circuit board (PCB) is used to connect different electronic components mounted on it using pathways or tracks which is etched from copper sheets. An automatic PCB defect detection is an approach that can used to counter difficulties occurred in manual inspection that can eliminate subjective aspects and then provide fast assessments. This project different approach have been implemented on reference and test PCB images to detect defects on bare PCBs before etching process, since etching usually contributes most destructive defect found on PCBs. We first compare a PCB standard image with the PCB test image using simple subtraction algorithm that can highlight the main problem regions. The defects that can be detected are over etchings (opens), under etchings (shorts), holes, etc.
Key words: Printed Circuit board (PCB), Image Processing

I. INTRODUCTION

Bare PCB is a PCB without any placement of electronic components & is used along with other components to produce electric goods. In order to reduce cost spent on manufacturing caused by defected bare PCB, the bare PCB must be inspected. These defects can be detected manually by inspectors. But manual inspection is slow and less consistent, whereas automatic inspection systems detect the defects fastly.

The automatic inspection is important because it removes the subjective aspects and provides fast and quantitative assessments. It also relieves human operator from tedious, boring and repetitive task of inspection. On the other hand automatic systems are consistent.

PCB inspection could be separated into two main stages:

1) The defect detection, and
2) The defect classification.

In defect detection, it is not important to know the type of defects. But in the defect classification, it is desired to know the type of the detected defects. Defect classification will take place after the defect detection mechanism has been carried out.

Defect detection techniques can be classified into three major classes:

1) Reference based approaches
2) Non-reference based approaches
3) Hybrid based approaches

The reference comparison approach is based on a comparison between the image of the PCB to be tested and an ideal PCB. He non reference method do not need any reference pattern to work with, they work on the idea that the pattern is defective if it not confirmed to the design specification standards.

The hybrid flaw detection method uses both referential and non-referential method & increases efficiency.

In this project we are going to use reference method. A template of defect free PCB image and a defected test PCB image are segmented and compared with each other using image subtraction method

II. LITERATURE SURVEY

Smita Jhajharia, Dr. S. K. Pal, Dr. Seema Vermasuggested the paper, in this paper wearable computing applications are reviewed from the early aircraft maintenance and military designs to current production models including designs for personal entertainment, communication and health monitoring. This paper also highlights the scope and market of wearable technology in India and the way in which it can bringrevolutionary changes in our country.

Shrenik Sarade, Nitish Jadhav, Mahesh Bhambure submitted a paper on patient monitoring and alerting system by using GSM. This project alert to Doctors /Nurse as well as patient relatives for take care of patient in the hospital also give the information about patient health & continuously alerting for the time to time providing the medicine to patient.

Ms. Priyanka Bhoyar, Dr.S.S.Sonavane submitted a paper on multi parametric health monitoring system. This article proposes the concept of Disease Detection Algorithm (DDA) for health monitoring. The DDA promises to provide higher accuracy of disease detection. Wireless sensor Network allows early home interventions thus reducing the number of subsequent hospitalizations system.

Automated visual inspection is required because of the following criteria

- They relieve human inspectors of the tedious jobs involved.
- Manual inspection is slow, costly, leads to excessive scrap rates, and does not assure high quality.
- Multi-layer boards are not suitable for human eyes to inspect.
- With the aid of a magnifying lens, the average fault-finding rate of a human being is about90%. However, on multi-layered boards (say 6 layered), the rate drops to about 50%. Even with fault free power and ground layers, the rate does not exceed 70%.
- Industry has set quality levels so high that sampling inspection is not applicable.
- Production rates are so high that manual inspection is not feasible.
- Tolerances are so tight that manual visual inspection is inadequate.

III. METHODOLOGY

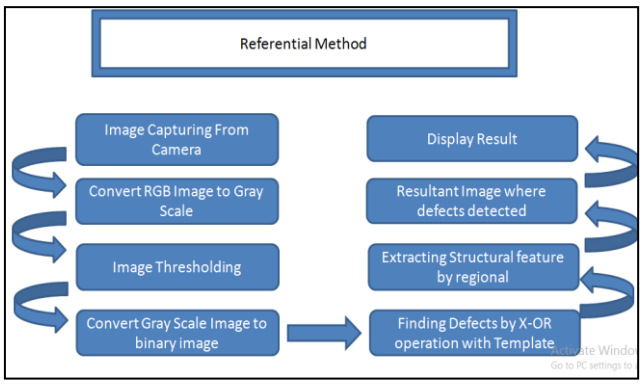


Fig. 1: Steps in PCB Defect Detection

A. *Capturing Image from Camera*

The image of PCB with no defects is loaded on the computer. The PCB which is to be inspected is placed on glass platform of suitable size. A camera is used for capturing image of the PCB. While capturing the image suitable light source is used. The captured image is loaded on to the computer. Web camera functionality is given to the camera to capture the image of the PCB mounted on the glass platform. The captured image will be used for further steps.

B. *Converting Image to Grey Scale*

In this we decrease the contribution of red colour and increase the contribution of green colour and contribution of blue colour is in between these two.

C. *Image Thresholding*

It is used to separate out the regions of the image corresponding to object from the regions of the image corresponding to background. Input to a thresholding is a grey scale image and output is binary image. In thresholding, first a value of intensity is considered as a constant known as threshold. Then each pixel in the image is compared with this threshold. If the pixel intensity is higher than the threshold, the pixel is said to be white (binary 1) in output. If it is less than the threshold it is said to be black (binary 0).

D. *XOR Operation*

XOR operation is done for image subtraction. In this pixels of the master image that is image with no defects are compared with the pixels of the image which is to be inspected.

This XOR operation is done as per following truth table—

Pixel(Image 1)	Pixel(Image 2)	Pixel(Output image)
0	0	0
0	1	1
1	0	1
1	1	0

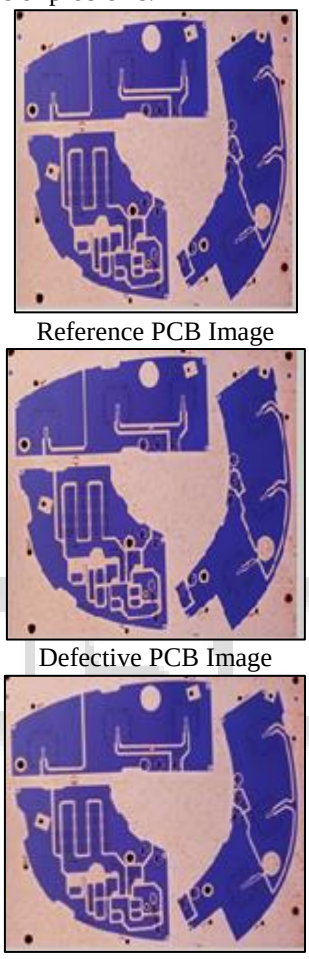
For image subtraction the size of both images should be same in terms of pixels.

E. *Resultant Image*

The resultant image obtained after comparing the image of the PCB with the master image. This image will display only defects found.

IV. RESULTS AND DISCUSSION

The identification of defects in PCB image is processed and the defect is identified with respect to the reference image using MATLAB tools. The below fig. Shows the bare PCB defect detection and sorting using image processing techniques. MATLAB features a family of add-on application-specific solutions called toolboxes. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems.



Reference PCB Image

Defective PCB Image

Pinhole Defect Identification

Fig. 2: Bare PCB Defect Detection and Sorting using Image Processing Techniques

V. CONCLUSION

The identification of bare PCB defects of natural images are sorted using image processing techniques and many practical issues like bad light conditions, height at which the images are taken etc., are considered in order to ensure the good quality of the image.

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