PCB DETECTION AND CLASSIFICATION USING DIGITAL IMAGEPROCESSING

[1] Shashikumar Vishwakarma, [2] SahilTikke, [3] Chinmay Manurkar, [4] Ankit Thanekar

[1,2,3,4] Electronics and Telecommunication (B.E), KJSIEIT, (India)

ABSTRACT

A Printed Circuit Board defect detection and classification system uses machine vision. Machine Vision helps counter difficulties that occur in manual inspection. It eliminates the subjective aspects and provides fast, quantitative, and dimensional assessment. Defects present in PCBs are short circuit, open circuit, pin hole, under-etch, mouse-bite and missing hole. These defects are classified using Image Processing techniques. The PCB inspection process is then improved using geometrical image registration so that any image which is different with the reference image can be aligned. This helps in accurate image processing results. Minimum Threshold technique is used to set a threshold level for the respective image and median filtering is used to solve the uneven illumination problem.

I INTRODUCTION

Bare PCB is a PCB without any placement of electronic components which is used along with other components to produce electronic goods. In order to reduce cost spending in manufacturing caused by the defected bare PCB, the bare PCB must be inspected.Image subtraction must be used to detect defects on the PCBs. However, image subtraction operation that has been utilized to detect defects between defective and template images cannot be used directly as it contributes unwanted noise due to misalignment and uneven binarization and thus, the accuracy of the defect detection could be decreased. Since the nature of real PCB images is different compared to computer generated PCB images, an image registration must be employed at first in order to get well-aligned defective image against template image. Then, all pixels in the template image are subtracted against the registered defective image to get two output images known as positive and negative images. Next, by applying image thresholding and filtering techniques, noise free positive and negative images are produced. Starting from here, the two images can be used as for the defect classification.Moganti et al. proposed three categories of PCB inspection algorithms: Referential approaches, Non Referential approaches and Hybrid approaches. Referential approaches consist of image comparison and model-based technique. Non-referential approaches or design-rule verification methods are based on the verification of the general design rules that is essentially the verification of the widths of conductors and insulators. Lastly, hybrid approaches involve a combination both of the referential and the non-referential approaches.These PCB inspectionapproaches mainly concentrated on defects detection. However, defects detection did not providesatisfactory information for repairing and quality control work, since the type of detected defects cannot be clearly identified. Based on this incapability of defects detection, defect

classification operation is needed in PCB inspection. Therefore, an accurate defect classification procedure is essential especially for an on line inspection system duringPCB production process. In literature, Wu etal.RudiHeriansyah and Abu-Bakar (2004), Rau and Wu (2005), and Ibrahim et al. (2011) have proposed PCB inspection systems in classifying defects. In this project, a new PCB inspection system on PCB images has been proposed by adapting similar algorithm that comes from Ibrahim et al., (2011).

II METHODOLOGY
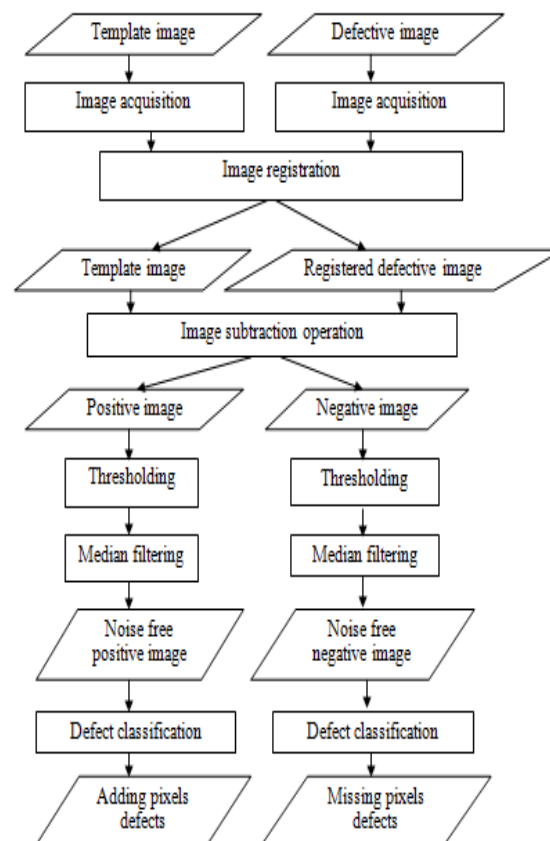
Some of the defects in PCB are short circuit, open circuit, pin hole, under-etch, mouse-bite and missing hole. In all these defects Open and short circuit are fatal defects while others fall under potential defects category. Assuming image has been registered. PCB images are available in computer database which are acquired from a camera device. After this we perform image complement. In image complement operation we take negative of the test image for further operations. After this we can use image subtraction to obtain the result. Image subtraction is an operation used to compare every pixel value and according to that difference is calculated. These differences are then compared to and presented in the form of equations. It is used after image registration. Images that we get from image subtraction are in positive and negative format. To convert those images in binary form we take threshold of the image. We use minimum threshold technique. In this technique a minimum threshold value is calculated and put as threshold. The value obtained in our case is 156. After getting result we need to classify them. Defects are classified using several operations like arithmetic and morphological operations. Following are the defects which are classified, defects in PCB are short circuit, open circuit, pin hole, under-etch, mouse-bite and missing hole.

III. RESULTS

Performing the following operations we can detect and classify the defects.
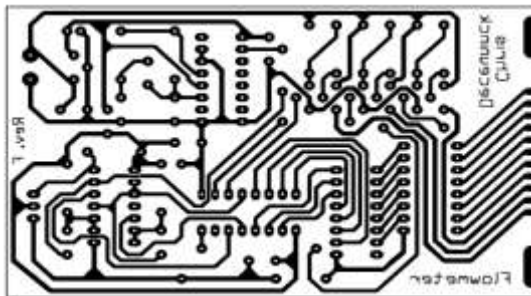
3.1 Hole Defect

Hole defect is one of the defects in which extra holes etched. Due to this the circuit malfunctions. To detect this defect we use image subtraction and subtract the template image and the obtained image to spot the difference and correct it. Below is the result obtained after subtracting the image.
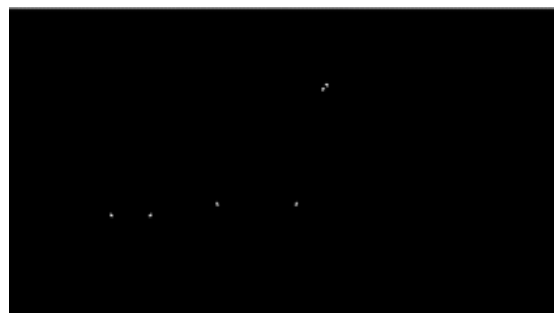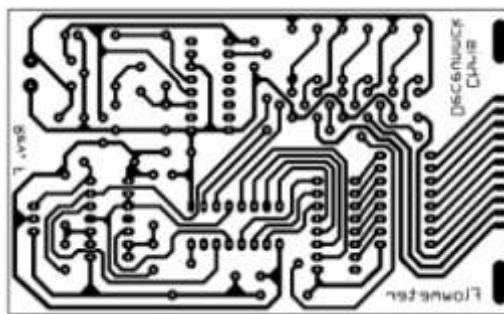

Image with defects

3.2 Open Circuit Defect

Open circuit defect is one of the fatal defects. In this some of the circuit lines don't get etched properly and there are cuts in the circuit due to which circuit is not complete. Same procedure as above is used to detect the defect. Reference image is subtracted from the negative of the defective PCB image. Hence the defect is detected.
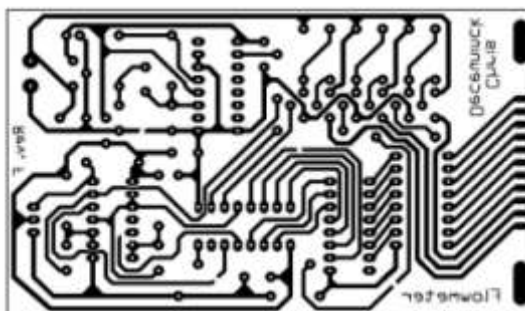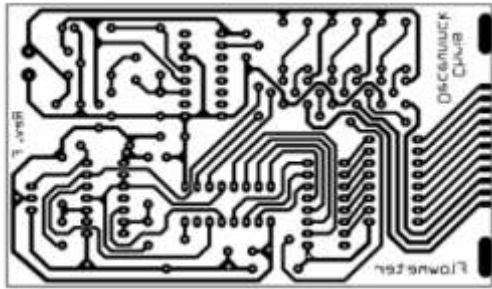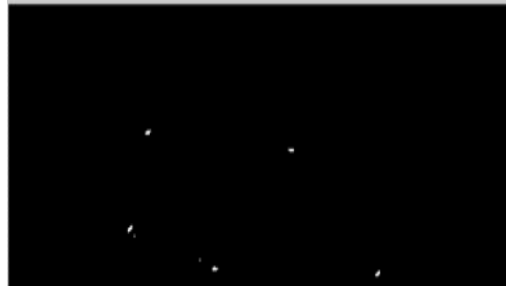

Open Circuit Defect   **Detected Defect**

3.3 Missing Pin Holes

In Missing Hole defect, the PCB contains some missing holes. These holes are crucial because they are to be used to connect resistors, capacitors etc. But since the holes are missing we cannot use them. Hence to detect this defect early we can we use a template image for reference and another image of the defective PCB. We use image subtraction and get the following result that is shown below.
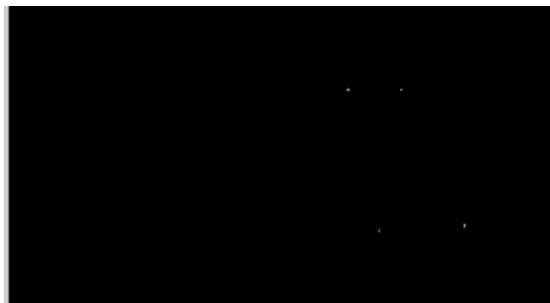
Missing pin hole defect   **Detected Defects**

3.4 Short Circuit Result

This is the second fatal defect after open circuit defect. In this defect when the PCB circuit lines are not spaced equally then the circuit lines get overlapped due to which the circuit gets short circuited. Same procedure as above is used to detect the defects. Below is the result obtained after using image subtraction procedure.
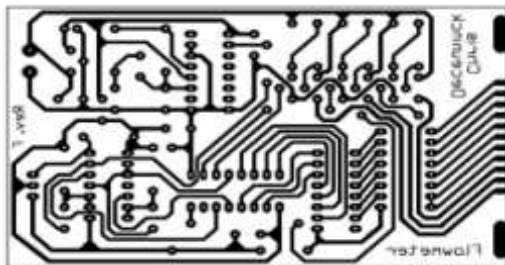
Short Circuit Defect   **Detected Defect**

IV CONCLUSION

Hence by using median filtering , image complement , image subtraction and by assuming images are registered successfully detected and classified the following defects ,WZ short circuit, open circuit, pin hole, under-etch, mouse-bite and missing hole in PCB using Digital Image Processing.

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