International Journal of Modern Embedded System (IJMES)
Volume No.-5, Issue No.-1, February, 2017
ISSN: 2320-9003(Online)

# PCB Quality Monitoring

Prof.S. R. Kurkute
E&TC Department
Sandip Foundation [SIEM]
Nashik, India
swapnil.kurkute@siem.org.in

Ms. Kakrale Priti Nivrutti
E&TC Department
Sandip Foundation[SIEM]
Nashik, India
pritikakrale@gmail.com

Ms. Kale Shraddha Sunil
E&TC Department
Sandip Foundation[SIEM]
Nashik ,India
kaleshraddha08@gmail.com

Ms.Kudav Aboli Santosh
E&TC Department
Sandip Foundation[SIEM]
Nashik,India
kudavaboli123@gmail.com

**Abstract:** Firstly, the uncovered PCBs (PCB Without components attached to it) were inspected consistently using manual inspection systems, this requires human operators. This technique is costly since it is highly error-prone Due to human error. The purpose of this project thus is to provide a different low-cost and generic defect detection technique. We wish to design a system which detects the faults based on reference digital image of the PCB using image processing technique. We are using machine vision concept to inspect the unclad PCB. We first compare a stored reference PCB image with a captured PCB image to be inspected using a simple image processing algorithm that can detect faults. Image processing method is one of the simplest ways for the testing of the PCB faults.

**Keywords:** Camera, DC Motor, RS232, Computer, Conveyor System, Image processing, PIC Microcontroller

## I. INTRODUCTION

A unclad printed circuit board (PCB) is a PCB that is used before the mounting of components and the soldering process. It is used along with other components to induce electronic products. There is the change in width of insulator and conductor because of manufacturing faults such as dust, over etching, under etching, and dummy metals, during the manufacturing of printed circuit board metals. Etching is the most important step in which unwanted copper is removed by preserving required copper patter. Unwanted copper is removed by means of chemical reactions. In order to minimize junk caused by the incorrectly etched PCB panel, testing has to be done in early stage. To reduce manufacturing costs associated with faulted unclad PCBs, the inspection of unclad PCBs is required as the most important step of the manufacturing process. This project is invented mainly by the demand for more efficient techniques in testing of PCB panel operators are assigned to each PCB panel.

This technique is manually operated hence it required large man power so it is not practically economical. In addition, this process is very time consuming that is why workers may tire out. Again, it is not possible to test entire PCB panels at every location without any deferment. Instead, the printed laminate is sampled a certain interval of quantity for manual testing. As the electronic circuitry technology advances, the PCB pattern becomes denser and complex to facilitate smaller end products. Thus, manual testing is not applicable anymore.

Now days, the advances in computers in term of high speed, extensive memory with low cost have resulted in better and cheaper equipment for image processing. Hence, there is requirement of automated system. At the same time, the automated PCB inspection system provides real time valuation of the PCB panel.

## II. LITERATURE REVIEW

Wu, et al. [1] has developed a pixel based approach for the performance and comparison. This paper was only algorithm designed for fault classification, at the time of writing, Pixel based approach classify seven defects (short, missing hole, pin hole, open, spar, etching problem and mouse-bite).Segmentation, windowing, defect detection, pattern assignment, normalization and classification these few stages involved in this approach.

Using neural network, Heriansyah, et al. [2], proposed a technique that classify PCB defect. This algorithm segments the images in to basic primitive patterns. Enclosing the primitive pattern, pattern assignment, pattern normalization and classification where developed using binary morphological image processing and LVQ (learning vector quantization) neural network. The PCB defect could be formed into three groups, the defects only on the foreground, the defects only on the background, and the defects on both background and foreground.

Ibrahim, et al. [3] proposed algorithm for defect detection only.Wavelet based image difference algorithm is used by this algorithm. The experimental result of this algorithm shows that the computational got reduced by 82.11 percent for defect detection.

Khalid, et al. [4] Proposed algorithm that can be implemented on the bare PCB to identify and to group PCB defects. However, the major limitation of this algorithm is that the proposed algorithm is developed to work with binary images only, whereas the output from the cameras is in gray scale format.

S. H Indera Putera, et al. [5], [10] did improvement in Khalid"s work by classifying seven groups. This is done by combining image processing algorithm and the segmentation algorithm.

## A.PCB FAULTS:

**1. Functional Faults**- The performance of the PCB can be affected or fails due to functional faults.

**2. Cosmetic Faults-**Cosmetic faults harm the appearance of the PCB, abnormal heat dissipation and distribution of current can also jeopardize its performance in the long run . There are 14 types of defects for single layer, unclad PCBs.

**Figure 1: Reference PCB** **Figure 2: Track Defective PCB**

Various faults on unclad PCB

1.Breakout

2.Pin hole

3.Open circuit

4.Under etch

5.Mouse bite

6.Missing conductor

7.Spur

8.Short

9.Wrong size hole

10.Conductor too close

11.Spurious cooper

12.Excessive short

13.Missing hole

14. Over etch

## III. DEFECT IDENTIFICATION METHOD

### A. Automated Optical Inspection (AOI):

Automated Optical Inspection (AOI) is an automated visual inspection of PCB where a camera independently scans the device under test for both catastrophic failure (missing component) and quality defects (fillet size/shape or component skew). It is a non-contact test method because of this it is commonly used in the manufacturing process. Through the manufacturing process Including bare board inspection, Solder Paste inspection (SPI),pre and post re flow it is implemented at many stages as well as other stages AOI for a bare PCB board inspection may detect these features

1) Line width violations

2) Spacing violation

3) Excess copper

4) Missing pad that is a feature that should be on the board is missing

5) Shorts circuits

6) Cuts

7) Hole breakage

### B. Computer Aided System for Fault detection:

Computer dependent defect detection is an diffusion of automatic optical inspection systems [1], the inspection and assembling processes of PCB are used by the previous system. For this purpose, ideal images are usually corresponding to both CAD/CAM/CAE software and predefined models by standard databases. The main problem of these techniques arises in obtaining accurate alignments and uniform lighting conditions on images. By the other side, the non-referential approach is mainly based on the design rule checking (DRC) method for unclad PCBs.

The same type of surface related defects can be detected by using automatic optical testing as same as that of manual testing.[3] including unclad board testing lack of solder, missing components, tomb stoning, lifted leads, solder bridging and solder balls. Automatic optical testing has the following characteristics that contact testing does not have1)It endorse potential faults such as out of line Widths, line spacing, pin holes, etc.2)Automatic testing can test art work and provides hard product Control from the onset of production.3) Automatic testing is a non-contact testing, thus avoiding mechanical damage.

### C. Image Subtraction Method:

We first compare a PCB stored reference image with a captured PCB image, using a simple subtraction algorithm that can highlight the main defective-region. We have observed affect of noise in a PCB image that at what level this method is suitable to detect the defective image. Our aim is to detect defects on printed circuit boards to observe the effect of noise. There is the need to improve the quality of PCB. There are defects, Misalignment and orientation error in manufacturing

industry so automated. To get the differences between two images, image subtraction operation is performed. The images are the reference image and the captured image. Using XOR logic operator, the method compares both images pixel-by-pixel.

The resulting image obtained after this operation contains defects. Either negative or positive image will produced when we perform the subtraction operation, 1 represents white pixel and 0 represents black pixel in a binary images There are two rules for image subtraction operation Rule 1: If 1-0 = 1 then it produces positive pixel image Rule 2: If 0-1 = -1 then it produces negative pixel image. For the image subtraction operation it is required that both images has unlike size in terms of pixels. The logical XOR operation gives defects in captured image as compared with reference image.

## IV. SYSTEM IMPLEMENTATION

Because decisions made by human inspectors often involve subjective judgment and involving a lots of effort and therefore costly, an automated approach for printed circuit board (PCB) inspection is preferred to eliminate subjective discrimination and thus provide fast, dimensional and quantitative assessments.

"The work aimed in detecting and classifying the defects on unclad single layer PCBs by introducing a hybrid algorithm."

Hybrid algorithm is a combination of both referential and the non-referential algorithms. Defect classification is essential to the identification of fault sources. Therefore, an algorithm for PCB defect classification is presented that consists of well known operations, including image addition image difference, image subtraction, counted image comparator, labeling for the classification of six different faults, namely, missing hole, pinhole, under etch, short-circuit, open circuit, and mouse bite.

### A. Parameters:

1. Line width violations.
2. Spacing violation.
3. Excess copper.
4. Missing pad that is a feature that should be on the board is missing.
5. Shorts circuits.
6. Cuts.
7. Hole breakage.

## V. APPLICATIONS

1. Automatic visual inspection.
2. Faulty component identification.
3. Automatic surface inspection systems.

## VI. CONCLUSION

The algorithm will detect the defects like wrong hole size, short circuit, etching, missing conductor using Image processing technology. This concludes that the size of defect is also minute and actually may be less than 30 micron. These defects are not easily identify by the human eyes and would take too much time. Because of this reason, an automatic visual inspection system is required. As a conclusion, this algorithm can be implemented on bare PCB to identify PCB defects. This algorithm can provide low cost and efficient with time.

## ACKNOWLEDGEMENT

We would like to express profound gratitude to Dr. M.P.Ray (Principal, SIEM Nasik) for his valuable support, encouragement, supervision and useful suggestions throughout this work. Also to Dr. D. P. Patil, Prof. B.D. Deore, Prof. P.P. Chaudhari and Prof. P.S.Sonar of department of Electronics & Telecommunication for moral support and continuous guidance enabled us to complete this work successfully.

## REFERENCES

[1] Wen-Yen Wu, Mao-Jiun J.Wang and Chih-Ming Liu,Automated Inspection of Printed Circuit Board Through Machine Vision" Computers in Industry year = 1996, volume = 28.

[2] R. Heriansyah, S.A.R AI-Attas, and M.M. Ahmad Zabidi, "Segmentation of PCB Images into Simple Generic Patterns using Mathematical Morphology and Windowing Technique", Malaysia 2002.

[3] Z. Ibrahim, S.A.R AI-attas and Z. Aspar, 'Analysis of the WaveletBased Image Difference Algorithm for PCB Inspection', in proceedings of SICE, Osaka, Japan, 2002.

[4] N.K. Khalid, "An Image Processing Approach Towards Classification of Defects on Printed Circuit Board," Projek Sarjana Muda, Universiti Teknologi Malaysia,,2007.

[ 5] S.H Indera Putera, Z.Ibrahim, "Printed Circuit Board Defect Detection Using Mathematical Morphology and MAT LAB Image Processing Tools," Universiti Teknologi MARA, 40450 Shah Alam, Selangor Malaysia, vol. 5, pp. 359–363, 2012.

## AUTHOR'S BIOGRAPHY

**Prof. Swapnil R. Kurkute - Received BE in Electronics and Communication Engineering and ME in Communication from North Maharashtra University, Jalgaon-Maharashtra. Presently working as a Assistant Professor in department of Electronics and Telecommunication Engineering of sandip foundation's SIEM, Nasik.**

ISSN: 2320-9003(Online)

**Ms. Priti N. Kakrale studying in final year Electronics and Telecommunication Engineering in sandip foundation SIEM, Nashik.**

**Ms. Shraddha S. Kale Completed Diploma in Electronics and Telecommunication Engineering from MSBTE. Studying in Final year Electronics and Telecommunication Engineering in Sandip foundation SIEM, Nashik.**

**Ms. Aboli S. Kudav studying in final year Electronics & Telecommunication Engineering in sandip foundation SIEM, Nashik.**