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## PCB Fault Detection Using Image Processing

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**Abstract:** The importance of the Printed Circuit Board inspection process has been magnified by requirements of the modern manufacturing environment where delivery of 100% defect free PCBs is the expectation. To meet such expectations, identifying various defects and their types becomes the first step. In this PCB inspection system the inspection algorithm mainly focuses on the defect detection using the natural images. Many practical issues like tilt of the images, bad light conditions, height at which images are taken etc. are to be considered to ensure good quality of the image which can then be used for defect detection. Printed circuit board (PCB) fabrication is a multidisciplinary process, and etching is the most critical part in the PCB manufacturing process. The main objective of Etching process is to remove the exposed unwanted copper other than the required circuit pattern. In order to minimize scrap caused by the wrongly etched PCB panel, inspection has to be done in early stage. However, all of the inspections are done after the etching process where any defective PCB found is no longer useful and is simply thrown away. Since etching process costs 0% of the entire PCB fabrication, it is uneconomical to simply discard the defective PCBs. In this paper a method to identify the defects in natural PCB images and associated practical issues are addressed using Software tools and some of the major types of single layer PCB defects are Pattern Cut, Pin hole, Pattern Short, Nick etc., Therefore the defects should be identified before the etching process so that the PCB would be reprocessed. In the present approach expected to improve the efficiency of the system in detecting the defects even in low quality images

Keywords: PCB, Defect detection, MATLAB, Image Processing.

### I. INTRODUCTION

Printed circuit board is a platform which mechanically supports and electrically connects electronic components on a composite sandwich of conductive and non-conductive layers with a well-defined and designed circuitry. The conductive layer is generally copper although aluminum, nickel, chrome and other metals are used, the non-conductive layer is generally a composite of epoxy and glass fibers. Printed circuit board (PCB) fabrication is a multidisciplinary process, and etching is the most critical part in the PCB manufacturing process. The main objective of Etching process is to remove the exposed unwanted copper other than the required circuit pattern. In order to minimize scrap caused by the wrongly etched PCB panel, inspection has to be done in early stage. However, all of the inspections are done after the etching process where any defective PCB found is no longer useful and is simply thrown away. Since etching process costs 70% of the entire PCB fabrication, it is uneconomical to simply discard the defective PCBs [1]. In this paper a method to identify the defects in natural PCB



images and associated practical issues are addressed using Matlab tools and some of the major types of single layer PCB defects are Pattern Cut, Pin hole, Pattern Short, Nick etc., Therefore the defects should be identified before the etching process so that the PCB would be reprocessed.

## II. METHODOLOGY

Quality is a measure of success in production of manufacturing facilities, hence an attempt is often made to achieve 100% quality assurance, so the best and simple way to achieve product quality is by ensuring defect free product from each process. Therefore in this system a PCB inspection is proposed and the algorithm mainly focuses on the defect detection. According to Khalid the methods of PCB defect detection is generally classified into two groups, which is image subtraction and feature extraction [5].

### ➤ *Image subtraction*

Image subtraction is the simplest approach of PCB inspection. The PCB to be inspected is compared with the reference image and the subtracted image shows defects. Normally used operation is XOR and the method has an advantage that it allows for verification of overall defects in the geometry of the board, but the disadvantage is that it suffers from the practical problems such as reflectivity variation, lightning sensitivity, image registration, and color variation.

Defect = abs (reference PCB image – Defected PCB Image).

### ➤ *Feature extraction*

In pattern recognition and image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and is suspected to be redundant then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the relevant information from the input data is extracted in order to perform the desired task.

## III. PROPOSED METHOD

We use MATLAB as a tool to perform various tasks of defect detection in PCB. MATLAB is a name that stands for matrix laboratory which is a high-performance language for technical computing. It integrates computation, visualization, and programming in an environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include

- Math and computation
- Algorithm development
- Data acquisition
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building

The goal of the implementation phase is to translate the system design into code in a given programming language that can be executed by the computer and performs the computation specified by the design. Therefore in this proposed method we work with natural PCB images, that is the distance from where the image is taken varies all the time so the

above two methods does not handle the distance issue and at the time of testing it does not match with the reference image. This problem is handled here by dividing the image into smaller sub images i.e. extracting the portion of the blue shaded area of the PCB images. These division is done even for the reference image and both these are compared to detect

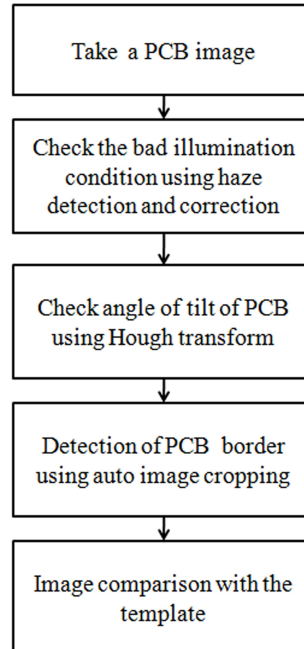
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This problem is handled here by dividing the image into smaller sub images i.e. extracting the portion of the blue shaded area of the PCB images. These division is done even for the reference image and both these are compared to detect defect. Since we are handling the real image we concentrated our study on

- Angle of tilt of PCB
- Vertical distance at which the images are captured
- Images at with bad illumination conditions

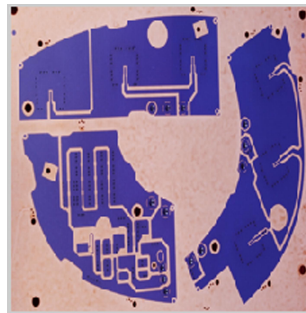
As shown in Fig.1 firstly the reference and defective image is selected and the difference is found out. The region properties of this difference is calculated and saved to the database.



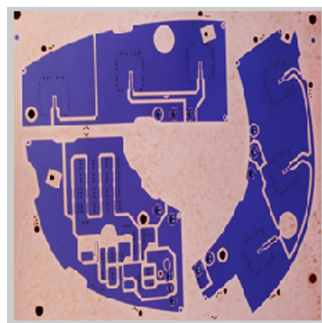
**Fig. 1: Flow chart for creating the database**

#### IV. RESULTS AND DISCUSSION

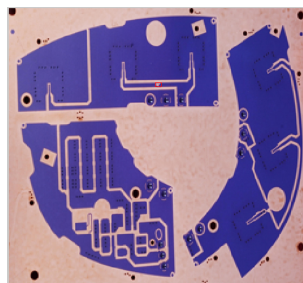
The identification of defects in natural PCB images is processed and the defect is identified with respect to the reference image using MATLAB tools. The Fig.2 below shows the bare PCB defect detection and sorting using image processing techniques. Thus the MATLAB features a family of add-on application-specific solutions called toolboxes. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems and many others



**A.Reference PCB Image**



**B.Defective PCB Image**



**C.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 tilt of the images, 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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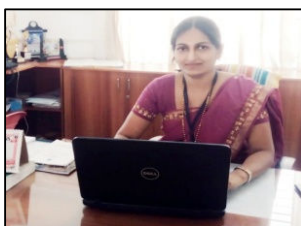




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