Components Free Electronic Board Defect Detection and Classification Using Image Processing Technique

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***Abstract*—— Components Free Electronic Board (Bare PCB) is the fundamental components of the Electronic device. The defect detection and recognization is an important procedure before placing the components on to the printed circuit board (PCB). The MATLAB tool is used to detect the defect and to classify the defects. Defect classification is essential to the identification of the defects. These Electronic components depend on the quality of PCB's. This plays a significant role in Electronic Industries. The main aim of the project is to identify and detect the defects so that the electronics board is defect free. Using the subtraction method the defects are identified and a different algorithm is introduced to classify the defects.**

Key words: - Image processing, image subtraction, flood fill operation, image complement.

I. INTRODUCTION

Components Free Electronic Board is a Bare PCB without any placement of electronic components. A Printed Circuit Board gives the mechanical supports and electrically connects electronic components using conductive track, pads and other features etched from copper sheets laminated onto a non conductive substrate. Albert Hanson, a German scientist is inventor of Printed Circuit Board. PCBs can be single sided, double sided or multi layer. Conductors on different layers are connected with plated through holes. FR 4 glassy epoxy is the primary insulating substrate upon which the vast majority of rigid PCBs are produced. A thin layer of copper foil is laminated to one or both sides of an FR 4 panel. Circuitry interconnections are etched into copper layers to produced Printed Circuit Boards. When the board has only printed connections with no components mounted on it this is called Bare Printed Circuit Board

In the development of technology, image processing and computer vision have got a rapid development in recent years. Rather than the manual inspection computer vision technique is playing an important role in advanced automatic industry. In order to reduce the cost in manufacturing of electronic board, defects in the bare PCB's must be identified. Many researchers have done a lot of works regarding PCB inspection.

This project separates the defects into different types of defects. This increases the efficiency of the inspection system in classifying defects.

In any electronic equipments defects free boards are required to give good performance. But while manufacturing board a defect usually occurs, and it effects for the quality of the products. Hence, quality of the product is reduced. So, if these defects are identified before placing the components, hence the detection is required to identify the defects in the printed circuit board. So, the different algorithm is used to identify and classify the defects.

The PCB's are manually inspected at every stage of production, but there are many drawbacks in human inspection as stated,

- More chances of mistakes due to human error
- Slow and less consistent than automated inspection system
- The circuits on PCB's are becoming much finer and more complex , making human visual inspection a challenge

The above problem increases as the board becomes more complex. Thus we require an efficient inspection system.

II. LITRATURE SURVEY

Siti hazurah indera putera et al., have classified the image into different types of defects and defects are detected using image subtraction method [4]

Jianjie Ma et al., have done the PCB inspection on computer vision technique and also some image processing like gray conversion and image subtraction [1]

S.H Indera putera et al., they worked on classifying the defects by image processing techniques like flood fill operation, image complement and image [2]

Beant Kaur et al., in their paper they presented the project using GUI creation which gives the ease of presenting and using the implementation [9]

Mr.Akash et al., they classified the defects and defect is detected using image difference method and by using gray thresholding [10]

Ms.Gagandeep Kaur et al., in these they have classified the defects into smaller and larger groups [3]

Ms.Vinital et al., in their paper they worked on image difference method and classified the defects with different algorithm [7]

Sonal D Kalro et al., they have classified the defects up to 4 different defects they have identified the defects [8]

III. METHODOLOGY

This paper presents about defect detection and classification of defects before that the preprocessing steps should be followed like image resizing, gray conversion and filters to get good quality image.

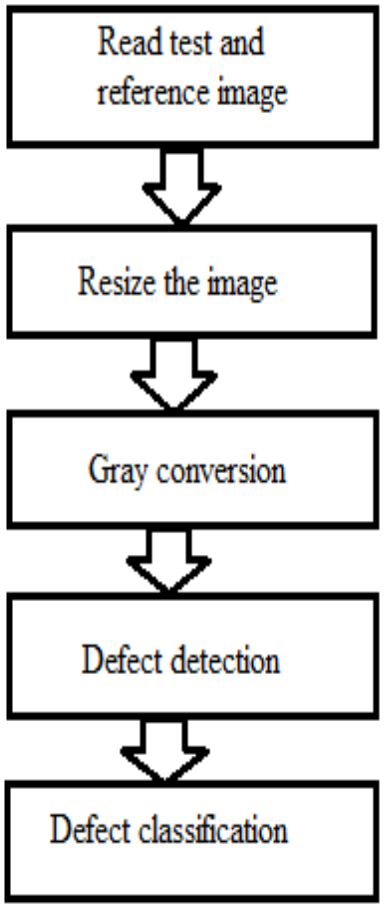

Fig 1:- Flow diagram of proposed methodology

Step 1:- Read the reference and test image

For the defect detection process the reference image and test image is required and at this step both the images are taken. The reference image is a defect free image and test image is defect free image.

Step 2:- Resize the image

Some times the size of the reference and test image varies these images should be resized for the equal dimension, so that further image processing can be carried out easily.

Step 3:- Gray conversion

Both reference image and test image should be converted to color image to gray scale image. The color image will be in 3 dimensional so this should be converted to 1 dimensional image which will easy for the image processing techniques.

Step 4:- Defect detection

This step includes image difference technique. Image differencing is an image processing technique used to determine changes between images. The difference between two images is calculated by finding the difference between each pixel in each image.

For the detection test image is compared with reference image and the overall defects are identified. In the image subtraction we get two outputs they are positive image and negative image.

$$I(p) = Im(r) - Im(t)$$

$$I(n) = Im(t) - Im(r)$$

Where, Im(r) is reference image
Im(t) is test image
I (p) is positive image
I (n) is negative image

Step 5:- Defect classification

The different algorithm as been introduced to classify the defects and the following are the different classifications. We have classified the six different defect types.
They are:

- Wrong sized hole
- Missing hole
- Missing track
- Etching defects
- Break lines
- Pin hole

A. Classification of the wrong hole size defect

Algorithm for Classification of the wrong hole size defect is as shown in fig 2. Difference of reference and test image is

operated this results in negative image and the complement of test image is preceded for the flood fill operation.

The negative image and flood fill image is subtracted and this resulting image is again subtracted with flood fill image this results the wrong size hole defect.

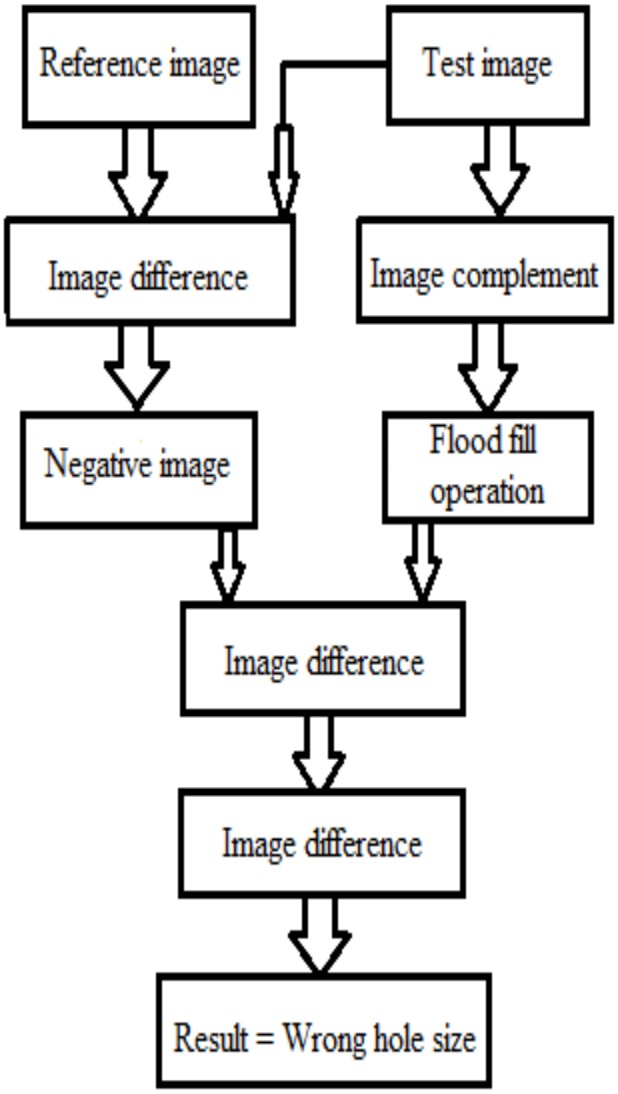

Fig 2:- Algorithm for wrong hole sized defect.

B. Classification of Etching defect

The algorithm for etching defects is shown in the fig 3. In this difference of test and reference image is taken which gives the positive image. Complement of the reference image is proceeded for flood fill operation and these two positive and flood fill image is again subtracted which results in etching defects.

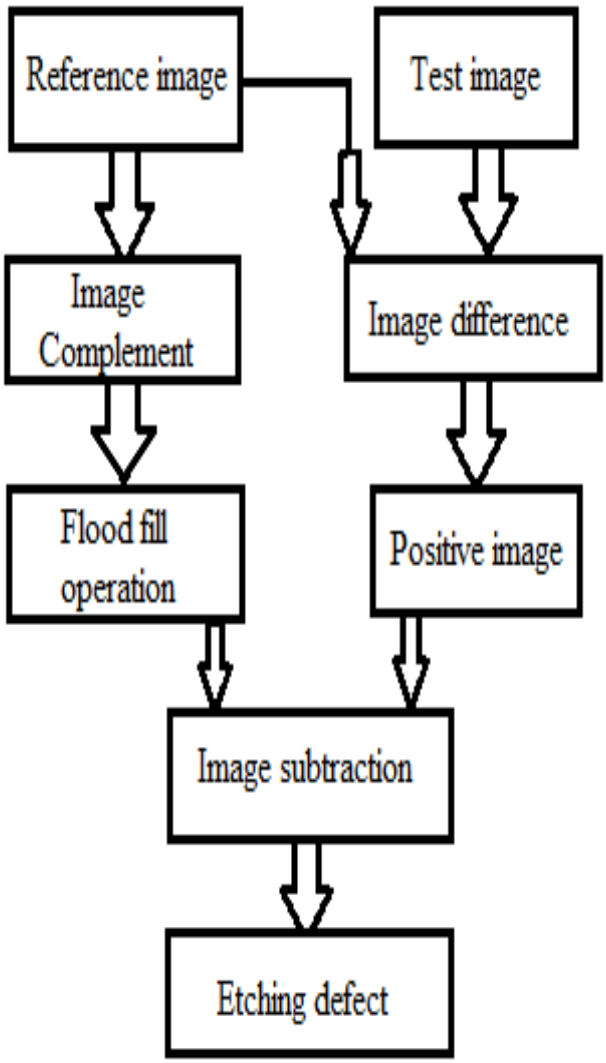

Fig 3:- algorithm for etching defects

C. Classification of missing hole defects

Algorithme for classification of missing hole defect is show in Fig. 4. In this difference of test and reference image is taken which gives the positive image. Complement of the reference image is proceeded for flood fill operation and these two positive and flood fill image is again subtracted and the result is subtracted with positive image which results in missing hole defect.

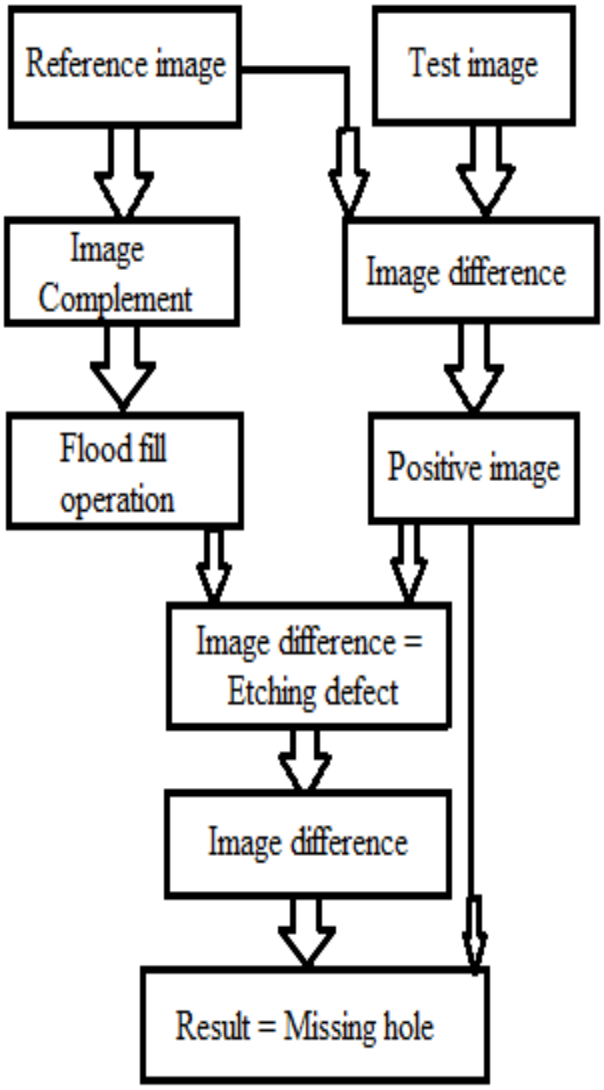

Fig. 4:- Classification of missing hole defect

D. Classification of missing track and break lines

These defect are identified by summing all the above classified defect result.

IV. RESULTS

The above techniques are used and tested for the defect images.

A. Defect detection :- For the give reference and test image the defect detection process is carried out and over all defect areas are identified and defect detection process is succeseful.

Fig. 5 shows the reference image and Fig. 6 shows the test image. These image are subtracted and defect are identified and over all defect are identified.

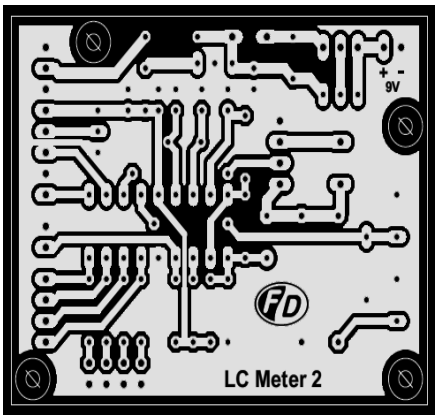

Fig. 5:- Reference image

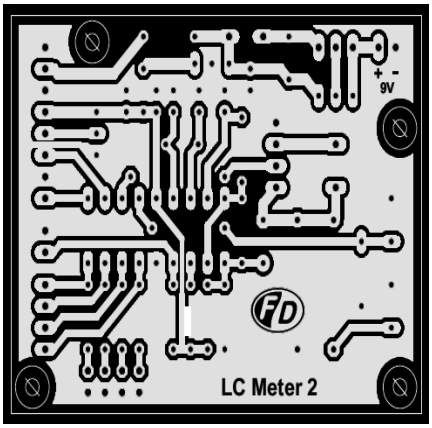

Fig. 6:- Test image

SL .NO	Defects	No. of Images	Detected and classified images
1	Break Line	30	30
2	Missing track	30	30
3	Missing hole	30	25
4	Wrong hole size	30	20
5	Pin hole	30	20
6	Etching defect	30	22
7	Under etch	30	15
8	Over etch	30	15
9	Mouse Bit	30	10
10	Open circuit	30	25

Table 1 :- Obtained result with respect to number of images

B. Classification of the defect

For the taken test image the above algorithme is applied and the defect are classified namely wrong size hole, missing hole, etching ddxefects, and missing track and break lines. In the above shown figure we observe the etching defect. And for the many test images the same algorithme is applied and the defect are identified and classified.

Fig. 7:- Over all defect

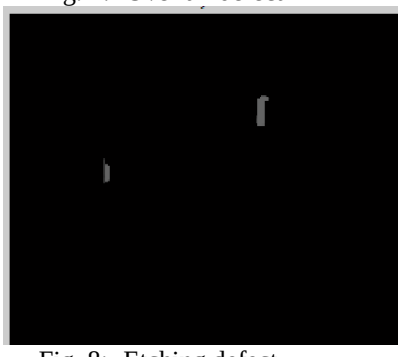

Fig. 8:- Etching defect

Fig. 9:- Missing track and pin hole

Fig. 10:- Missing track

Fig. 11:- Missing hole and wrong size hole

Fig. 12:- Pin hole

V. CONCLUISION

This project uses different algorithm for defect identification and classification. Here we have classified up to 7 defects and the defects are identified successfully. As we referred with the other paper and according to our literature survey a clear algorithm is not observed and less number of defects are classified and detected hence in this paper we concentrated on classifying more defects with an effective algorithm and defects are identified.

VI. REFERENCES

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