PCB Defect Detection Using Image Enhancement

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Abstract— **Printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks. Using PCB chances of miswriting or short circuited wiring are minimized .The location of electronic parts is fixed and inspection time reduced. Defects in PCB are in the form like missing hole, breaking lines, wrong hole size etc. Image Enhancement Technique is used for PCB defect detection and classification of defects. The main goals in Image Enhancement Technique are achieving high performance or efficiency and obtaining highly accurate results. This is to ensure a high quality PCB that translates to reliable and quality digital end products. To enhance this work, we are going to propose a printed circuit board (PCB) is the board base for physically supporting and wiring the surface mounted and socket components in most electronics. This paper proposes a PCB defect detection and classification system. Image enhancement techniques have been widely used in many applications of image processing where the subjective quality of images is important for human interpretation. It is sub area of image processing.**

Keywords- PCB; Defect detection; Image Enhancement

I. INTRODUCTION

Different technique are used for PCB but we are using Image enhancement. Enhancement operations are normally applied to image data after the appropriate restoration procedures have been performed. Noise removal, in particular, is an important precursor to most enhancements [1]. The principle object of image enhancement technique is to process an image so that the result is more suitable than the original image for a specific application. Enhancements are used to make it easier for visual interpretation and understanding of imagery [3][4]. The advantage of digital imagery is that it allows us to manipulate the digital pixel values in an image [5][8]. Although radiometric corrections for illumination, atmospheric influences, and sensor characteristics may be done prior to distribution of data to the user, the image may still not be optimized for visual interpretation. Remote sensing devices, particularly those operated from satellite platforms, must be designed to cope with levels of target/background energy which are typical of all conditions likely to be encountered in routine use [2][3]. With large variations in spectral response from a diverse range of targets (e.g. forest, deserts, snowfields, water, etc.) no generic radiometric correction could optimally account for and display the optimum brightness range and contrast for all targets. Thus, for each application and each image, a custom adjustment of the range and distribution of brightness values is usually necessary [1][8]. PCBs are used for large qty productions as wire wrapping can involve hours to complete just one unit. Populating a printed circuit board can be done in matter of minutes [4][9]. Looking at labor costs, there is a significant cost benefit to use a PCB. Also, the connections/joints of a populated circuit board can be wave soldered, which greatly improves reliability and quality of the product. Using a PCB allows the unit to be quality tested at the completion of the build with ease, vs. a wire wrapped or hand built unit. A PCB can then be conformally coated to resist corrosion.handle environmental conditions. Using a PCB vs. hand building also greatly reduces the likelihood of build errors (that is, miss connections, miss components, etc). Printed circuit board mechanically supports and electrically connects electronic components [5][6]. PCB defect detection has great impact on the PCB manufacturing caused by the defected PCB. In PCB there may be fatal defects or potential defects. Fatal defects are those in which the PCB does not attend the objective, they are designed for. In potential defects PCB compromises itself during utilization. In order to minimize scrap caused by the wrongly etched PCB panel, inspection has to be done in early stage. To reduce manufacturing costs associated with defected bare PCBs, the inspection of bare PCBs is required as the foremost step of the manufacturing process [4][5]. This project is motivated mainly by the need for more efficient techniques in inspection of the PCB panel in PCB fabrication process. Normally, a couple of operators are assigned in each station to manually check the PCB panels [3]. This technique is not economical in a long run as it takes many man hours. In addition, humans are prone to making

errors especially due to fatigue. Moreover, it is impossible to check the entire PCB panels at every location without any delay. Instead, the printed laminate is sampled a certain interval of quantity for manual inspection [6][7]. PCB defects can be categorized into two groups:-

1. Functional defects :- Functional defects can seriously affect the performance of the PCB or cause it to fail [6][7].

2. Cosmetic defects:- Cosmetic defects affect the appearance of the PCB, but can also jeopardize its performance in the long run due to abnormal heat dissipation and distribution of current [6][7].

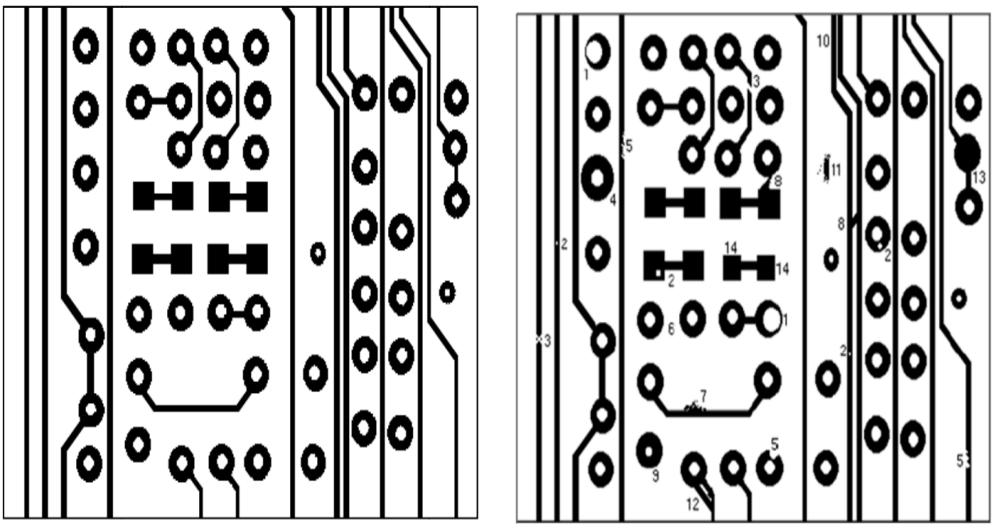

Figure 1.1: Template image of bare PCB [6] Figure 1.2: Defective image of bare PCB [6][7]

PCB inspection algorithms into three main categories:

1. Reference comparison (reference-based) approach - This consists of mainly two processes. The first step is the coarse alignment between the detected patterns and the design patterns. The second step is the defect detection named "Local Pattern Comparison" method[8][10].

2. Design-rule checking (non-referential) approach - This PCB fault detection technique can detect error in the PCB without considering a reference board[10].

3. Hybrid approach - Which involved a combination of reference comparison and design-rule approach? A system developed in this research can handle all of the defects simultaneously with the same approach and is significantly faster compared to the existing approaches[10].

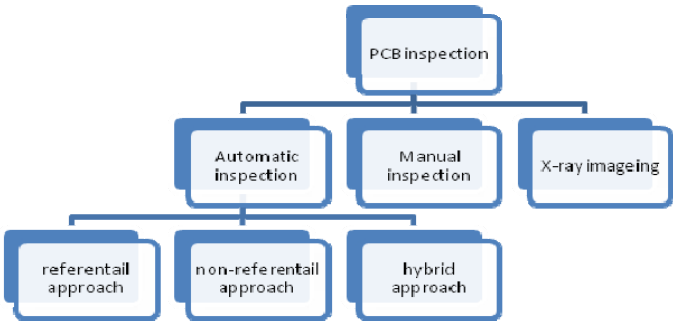

Fig ure1.3 . Classification of Detection techniques[2]

II. LITRATURE SURVEY

2011 Ajay Pal Singh Chauhan- The bare PCB is analyzed and the defects of PCB are extracted in terms of various parameters. These parameters can be taken as referential data base for further analysis to fabricate defect free PCB and can assist in making an automated system for inspection. In order to use this method in an industrial application some improvements need to be done. Future work consists of inspecting and analyzing a PCB with Surface Mounted Devices.

In 2013 Yang Halin- This used linear transformation method in enhancement of image characteristic then gray scale statistical matching method is used to detect the defects.

Zuwairie Lbrahim-An automated visual printed circuit board (PCB) inspection system proposed in this paper is designed specifically to detect various types of defects occurred during circuit printing process in manufactory. Two-dimensional HAAR wavelet transform is incorporated in the PCB inspection algorithm of the inspection system. During the inspection, two type of images are required; reference and tested PCB images. The wavelet transform is applied to the reference and tested PCB images. According to previously proposed wavelet-based PCB inspection algorithm, a reference comparison between the reference and tested PCB images has been done in wavelet domain by employing image difference operation. However, in practice, this operation also bring along the unwanted noise due to misalignment and uneven binarization. Thus, in this paper, for the real-time implementation, the image difference operation between the reference and tested PCB images is replaced with image subtraction. The output of the image subtraction operation can be differentiated as positive, negative, and zero images.

In 2014 Kaur Kamalpreet- The detection and classification results of proposed method are promising. Most of the defects like wrong size hole, missing hole, missing conductor, pin hole are successfully detected without any misclassification. The proposed method has some drawbacks like it require the same size of template and defective images. And it requires orientation of test image and base image. Also during computation of defect detection and implementation this operation bring along the unwanted noise due to misalignment PCB have been proposed in the literature to Moganti divided the PCB inspection algorithms into three main categories:

1. Reference comparison (reference-based) approach

2. Design-rule checking (non-referential) approach

3.Hybrid approach which involved a combination of reference comparison and design-rule approach.

Beant Kaur-The method for detection and classification of defects in Printed circuit boards using image subtraction has been presented in this paper. Image subtraction method is one of the simplest methods for the inspection of the PCB defects. The defects like missing hole, over and under etching, wrong hole size defects, missing conductor and break lines have been detected and classified in this paper. It is concluded from the results that defects can be detected and classified easily with the help of image subtraction method. But image subtraction has some drawbacks like it require the same size of base and test images. And it requires orientation of test image and base image.

In 2015 Namita Kalyan Shinde -This provides a design of PCB automatic defect detection system based on image processing technology. This design is a non-contact, fast, accurate and highly effective detection. This PCB defects detection technology which can not only detect open circuit and short circuit, but also can detect wire gaps, voids, scratches defects etc. For further improvement extracting the structural features based on these regional properties gives the detailed information about the defects.

Mukesh Kumar1-An Algorithm for PCB image enhancement as well as standard data generation for defect detection in bare PCB is proposed in this paper. The quality of PCB image is enhanced using color plane extraction, LUT transformation, thresholding, Filtering, and Advance morphology after that standard data is generated by Particle analysis. In future, this standard database will be used in referential approach of PCB defect detection. Time taken to execute the proposed algorithms 14 ms means 71 PCB can be inspected per second.

Surendra Khushwaha- A Computer Vision system for printed circuit board (PCB) automated inspection was developed to detect bare-board manufacturing errors, like missing tracks, circuit shorts, missing holes, opens, breaks, etc. The system uses standard PCB images; their characteristics are saved in a database. The adopted referential approach compares PCB images to the standard images. Some difficulties were observed. One of them consists in the pre-processing technique. It is important that the environment lighting should be uniform and that all inspected PCB belong to the same category. It permits to choose a satisfactory segmentation technique, which can be applied to all PCB images. In the other hand, if it doesn't happen, it will be necessary to calibrate the system every time we change the reference PCB or environment illumination attempting to detect PCB fails, we propose a new methodology that reduces the computer complexity of scanning the whole board. We considered the PCB separated in small images. It is possible after the system identified the regions that contain fatal errors. A connection analysis method is applied to each small image.

Mohit Borthakur-Automatic PCB inspection is needed to inspect the PCB for defect, anomalies and fault. Among the variety of algorithms, the image difference operation has been emphasized more in order to get better results. The system proposed is not a generalized system but a dedicated system for a particular PCB and can be optimized to a level. This has also been noted that the system cannot be generalized as each PCB inspection is different from its assembly point of view. Hence it is noted that different operations are found suitable for different PCBs according to its features. The drawbacks of different proposed algorithms have been studied and accordingly an optimal approach is used to minimise the shortcomings and increase the operation

speed. The major limitation of existing inspection systems is that all the algorithms need a special hardware platform to achieve the desired real-time speeds. This makes the systems extremely expensive. Any improvements in speeding up the computation process algorithmically could reduce the cost of these systems drastically.

III. METHODOLOGY

a) All operations are GUI based.

b) To Read the PCB that is to be tested.

c) Enhance the Image. Since Input image can come through Noisy source so we are removing the Noise and enhancing the contrast of received image.

c) Using Image Subtraction operation we are finding the errors.

d) Hybrid inspection approach is used for defect detection.

e) Defect detection.

IV. PROPOSED MODEL

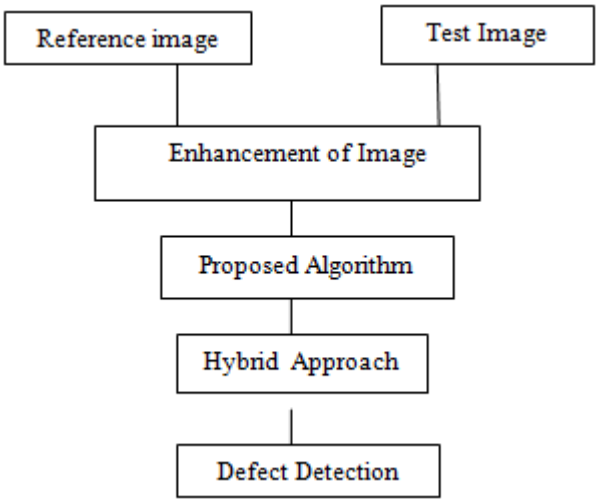

Figure1.4

V. CONCLUSIONS

The result is that we are detecting the PCB defects using image enhancement technique. In this quality the image is enhanced using transformation thresholding, filtering and morphology. PCB inspection is needed for inspect the defects, anomalies and faults. Defects in PCB are in the form like missing hole, breaking lines wrong hole size etc are detected. This has also been noted that the system cannot be generalized as each PCB inspection is different from its assembly point of view. Hence it is noted that different operations are found suitable for different PCBs according to its features.

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