DEFECTS DETECTION IN PCB USING IMAGE PROCESSING AND DEEP LEARNING

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Abstract: Machine Learning methods are not much applied in the PCB defect detection process. Modern world is more adapted to Machine learning and Artificial intelligent applications. Many other sectors were already using applications based on these technologies. A printed circuit board or (PCB) is used to physically support and realistically connect electronic components using conductive pathways, track or signal traces etched from copper sheets laminated onto a conductive substrate. The self inspection of PCBs serves a purpose which is traditional in modern technology. The aim is to relieve human inspectors of the tedious and inefficient task of looking for those defects in PCBs which could lead to electric failure. We first compare a PCB standard image with a PCB image, using a simple subtraction algorithm that can highlight the main problem-regions. We have also seen the effect of noise in a PCB image that at what level this method is suitable to detect the faulty image. Finally, defect classification operation is employed in order to identify the source for six types of defects namely, missing hole, pin hole, under etch, short-circuit, mouse bite, and open-circuit.

Keywords: - ML, ANN, PCB, MAT LAB

1. INTRODUCTION

Bare PCB is a PCB with none placement of digital additives that is used in conjunction with other additives to provide digital goods. In order to reduce fee spending in manufacturing because of the defected bare PCB, the naked PCB need to be inspected. Moganti et al. (1996) proposed 3 classes of PCB inspection algorithms: Referential tactics, Non-Referential processes and Hybrid methods. Referential strategies encompass image comparison and version-based totally approach. Non-referential processes or layout-rule verification strategies are based at the verification of the overall design guidelines that is basically the verification of the widths of conductors and insulators. Lastly, hybrid processes involve a combination each of the referential and the non-referential methods. These PCB inspection approaches especially focused on illness detection. However, illness detection did now not offer first-class statistics for repairing and pleasant manage work, for the reason that sort of detected defects cannot be simply recognized. Based in this incapacity of disorder detection, disorder type operation is wanted in PCB inspection. Therefore, an correct defect class procedure is crucial especially for an online inspection gadget in the course of PCB production procedure.

2. IMPLEMENTATION

Neural Networks & Artificial Intelligence

In some circles, neural networks are thought of as "brute force" AI, because they start with a blank slate and hammer their way through to an accurate model. They are effective, but to some eyes inefficient in their approach to modeling, which can't make assumptions about functional dependencies between output and input.

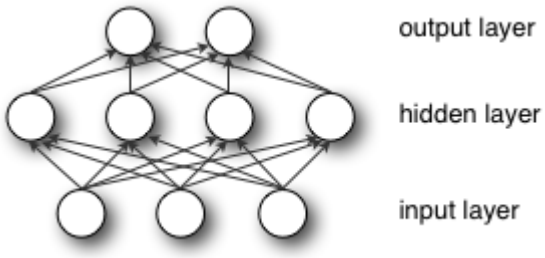

Fig:-1 Layers of ANN

KEY FEATURES

- Image enhancement, filtering, and deblurring. Image analysis, including segmentation, morphology, feature extraction, and measurement
- Spatial transformations and image registration
- Image transforms, including FFT, DCT, Radon, and fan-beam projection
- Workflows for processing, displaying, and navigating arbitrarily large images
- Modular interactive tools, including ROI selections, histograms, and distance measurements
- ICC color management
- Multidimensional image processing
- Image-sequence and video display
- DICOM import and export

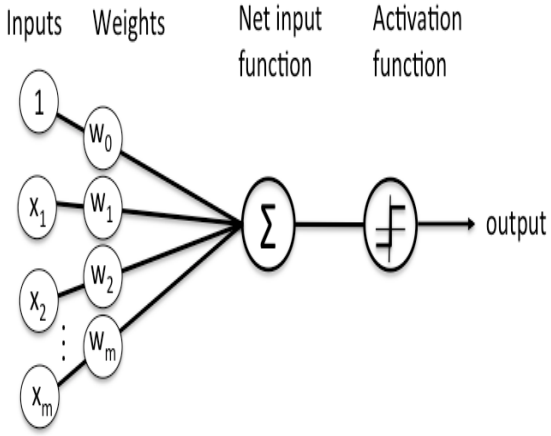

Fig:-2 Flow of the Algorithm

Flowchart

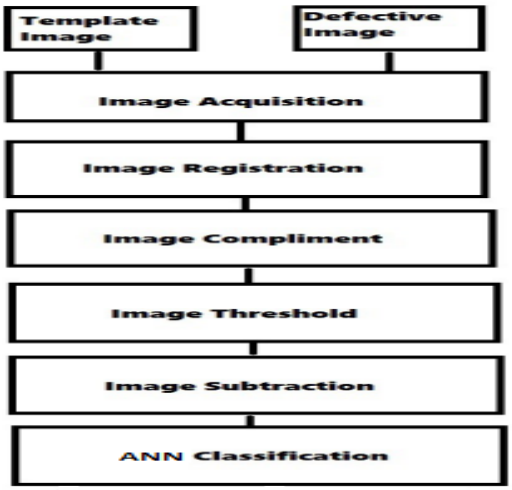

Fig:-3 Application Flow Chart

Image Acquisition

This step means acquiring the image that is to be checked for defects which could be of various image formats such as bitmap (.bmp), portable network graphics (.png), JPEG (.jpg), etc. Another Template/Reference image of a defect free PCB is taken as input which could also be of the same or different image format.

Image Registration

The template and Defective Image have different orientation and size, hence images are registered before the image operations. The pixels of both images are mapped according to their similar features in the image. For a rotated image the angle of rotation is calculated and the image is then re-rotated and resized for registration.

Image Complement

The Image of the PCB which is to be tested is to be complemented for subtraction and defect detection. The complementing of a 3D RGB image has to be done with the help of converting the image to Gray scale and then complementing. For Image complement Each pixel value of the image is subtracted from the highest value of the image i.e. if it is an 8-bit image maximum value is 2^8-1which equals 255.

Image Threshold

After Selection of the Defects the Images are Threshold according to their size and shape. Image threshold makes the pixel below a Threshold value zero i.e. black and pixel having value above the threshold value white. Hence this operation makes it easier for the appearance of PCB tracks more visible in an image. The image which is to be tested and the template image are given same threshold value to reduce complexity of the program.

Image Subtraction

After Image threshold is done the next step is image subtraction i.e. subtraction of defective image from the template image. The subtraction is done pixel by pixel of the template and the defective image. The Image registration provides easy access for image subtraction as an matrix operation.

Pixel Manipulation

The defects are seen as white spots in the resultant image caused by image subtraction operation. If no spots exist in the image it means that the PCB is not defective. If any spots are seen in the resultant image then defects exists in the image. The pixels having some value are detected and their value is manipulated to a specific color which is RED for UNDER-ETCH and GREEN for OVER-ETCH defects.

Classification

With the trained features Artificial Neural Network will compare the input feature and will give the result.

3. EXPERIMENTAL RESULTS

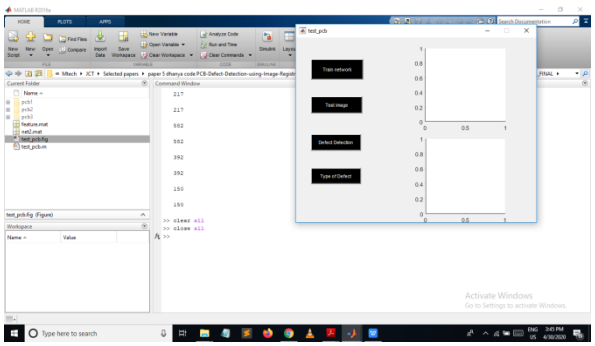

Fig:-5 Home Screen

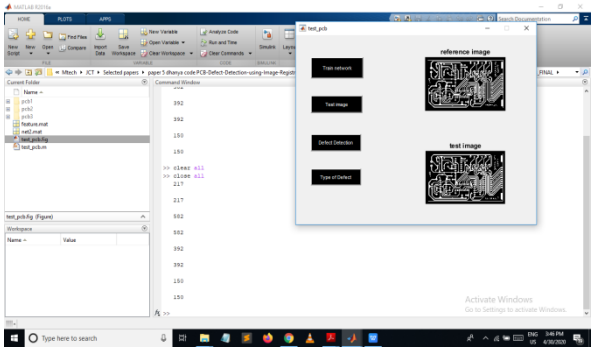

Fig:-6 Testing Screen

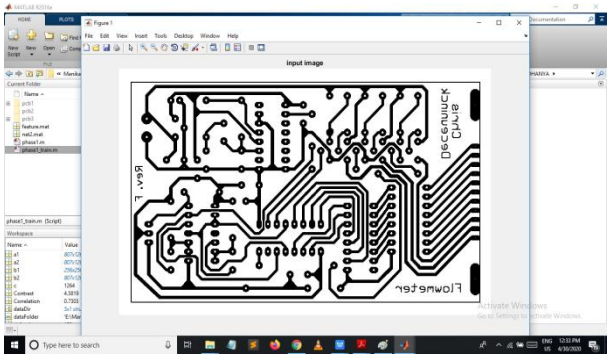

Fig:-7 Result Circuit Screen

4. CONCLUSION

We have presented the implementation of a technique to Detect PCB errors and classify them using Artificial Neural Network via MATLAB. Our technique shows that it is feasible to use the software and detect the errors present in PCB so that further malfunction can be avoided. Its objective is to detect the errors that are present in PCB during Mass Production. It can also be used in small scale like using it in college labs to detect the errors in PCB which engineering students have to make for their courses. We believe that PCB making or production can be increased efficiently and error rates can be reduced significantly by using this software.

5. REFERENCES

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