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PRINTED CIRCUIT BOARD FAULT DETECTION

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ABSTRACT :-*The prime intention of this paper is to disclose the defects that are introduced during production of printed circuit boards (PCB).The electronic gadgets possess a precise and distinct PCB designs. Carrying out the quality inspection of printed circuit boards is tedious. This complication can be eliminated by using image subtraction algorithm during the inspection of PCBs. In this paper, comparison of bare PCBs is processed by engaging image subtraction algorithm which was efficiently used in digital image processing. The error spots in the PCBs are identified and indicated in resultant image of the algorithm. The work was simulated and verified by using openCV software and Anaconda-Spyder package.*

Keywords: *Comparison, Digital image processing, Image subtraction algorithm, openCV, Printed circuit board, Anaconda-Spyder.*

I. INTRODUCTION

Manufacturing of printed circuit boards undergoes several processes such as cutting, drilling, printing, etching, masking, legend, v-scoring, tooling and finally quality inspection. If the board is found to be defective that they vary from actual design it will be rejected. Due to this, the time and cost consumed for manufacturing them is of vain. Man power is employed mostly for quality checking process which takes off more time and manufacturers fails to supply the product within the specified time. This causes drawback to the company. Here we solve this problem using software interaction by capturing images of bare printed circuit board by using web-camera. Code that compares both reference images that is without defects and inspected image is loaded to computer. Images are analyzed by pixel-by-pixel using XOR logic. Finally defects are differentiated in the resultant image.
Paper is coordinated as follows: part II Literature survey, part III Existing work, part IV proposed work
part V Hardware module, part VI Software module followed by result and conclusion in part VII.

II. LITERATURE SURVEY

A various type of printed circuit board inspection techniques are discussed in the literature to achieve defect free products in the process of manufacturing. PCB inspection based on a variant of the n-tuple technique proposed by Ouslim et al [1] helps to detect small defects in electronic printed circuit boards. This technique operates on a list of nine attributes formed in a 3 by 3 kernel. Automated inspection of printed circuit boards through machine vision by Wen-Yen Wu et al [2] developed automated visual inspection system for detection of PCB. Ibrahim et al [3] developed performance evaluation of wavelet-based PCB defect detection and localization algorithm which could be used for an automated visual PCB inspection system to achieve real time inspection. DM Tsai et al [4] introduced fast normalized cross correlation of defect detection. Automatic optical inspection for detecting defects on printed circuit board inner layers by H.Rau et al [5] proposed a boundary state transition method. K. Chomsuwan et al [6] introduced Improvement on Defect Detection Performance of PCB Inspection Based on ECT Technique with Multi-SV-GMR Sensor. MATLAB based defect detection and classification of printed circuit board by Siti Putera et al [7] Using Matlab image processing tools this research separates two of the existing groups containing two defects each into four new groups containing one defect each by processing synthetic images of bare through-hole single layer PCBs.

III. EXISTING PCB DEFECT DETECTION SYSTEM

Following brings out the existing methods of PCB defect detection system.

A. Manual approach

At initial days of PCB manufacturing, testing the quality of finished boards were carried out manually .It was efficient for less period of time. As number of electronic appliances is introduced day-by-day, need for printed circuit boards also tend to

increase. Man makes mistakes and so this approach had only bounded value. This unnoticed errors cause the boards to be rejected When they enter into assemble section. This method was not efficient in the manner of cost and time. This was the only method before automation entered into the inspection field. Continuity checking was done using digital multimeters and lenses are also used to in manual inspection.

Figure1. Manual inspection.

B. Automated optical inspection

This eliminates the repeatable checking that is done in manual visual inspection. Since number of boards to be delivered per day increased, automation method was insisted in PCB inspection process. Solder quality is not tested in AOI process. This process depends basically on machine in use. Presences of voids in solder joints are unnoticed in this process. It consumes large space for placing.

Figure 2. AOI tool for inspecting bare PCB

C. PCB inspection algorithms

In manufacturing of PCB's, if defect board is detected the capital that they spent for production is a loss. Few approaches are used in inspecting bare PCB's,

- Referential approach: It possesses comparison of images and based on model technique.
- Non-referential approach: Dimensions of conductors and insulators are verified using design rule which are important and they must be same as given in Gerber file given by customer.
- Hybrid approach: Collaboration of above two methods result in hybrid based approach

IV. PROPOSED WORK

In our proposal work, when bare board PCBs enter into quality inspection and testing unit of PCB manufacturing industries, with the help of camera the image is captured and processed by image subtraction code loaded in openCV. The image with a defect is compared with standard template that is defect free.

- RGB image is converted into grayscale image. This is needed because it utilizes only one channel of colour.
- Now grayscale image is transferred as binary image for easy and simple processing. Time consumption is reduced when compared to other detecting mechanism.

- The logical XOR operation will show us the defect in inspected image compared with reference image.
- It provides efficient service to manufacturers and reduces workload of employee. Proper monitoring facility is enhanced.

Fig below provides the block model of the work.

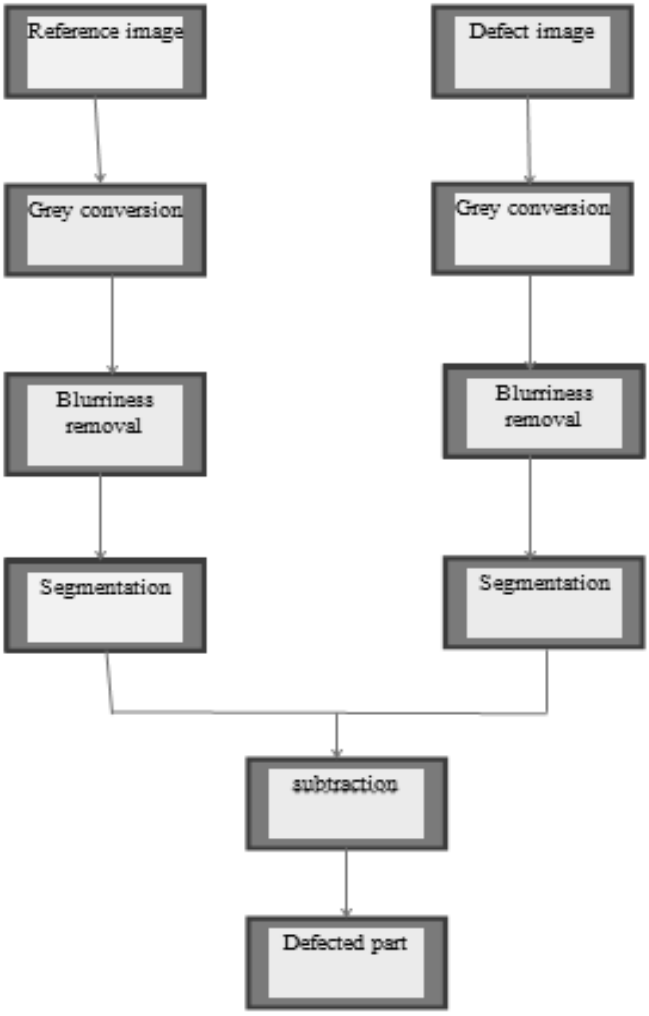

Figure 3. Block model of the proposed work

LOADING IMAGE FROM COMPUTER

The image of the printed circuit boards are captured by using web-cam. The reference image of printed circuit board is uploaded and the image to be inspected is loaded one by one for comparison and defect detection.

CONVERT THE IMAGE TO GRAYSCALE IMAGE

Loading of the RGB image, reference and defected image are done. Both images are converted to grayscale. Only less amount of information is provided to pixel henceforth, we grayscale those images. The red, green and blue channel of colors has equal intensity in RGB space and so, we convert into gray. Necessity to specify the three intensities value for each pixel, has been eliminated. We need to provide only the intensity value for gray.

THRESHOLD THE IMAGE

Partitioning an image is done by technique called image thresholding.They split it as foreground and background. It converts image with grayscale format into binary format and object is isolated which is result of image segmentation. Images possessing peak levels of contrast has effective benefit due to thresholding. Multi-level thresholding and histogram are algorithms for image thresholding.

CONVERT TO BINARY IMAGE

Binary image have only pixel value '1' or '0' that ease complication that occur in process. Therefore, conversion is done from grayscale format.

XOR OPERATION ON THE IMAGES

Both the binary images are subjected to XOR operation to detect the error region .To detect the difference between the two images subtraction operation is used. The resulting image involving defects are shown. Negative or positive pixel value is result of subtraction operation. The payoff of this operation is divided as positive image and negative image.

Pixel [Image 1]	Pixel [Image 2]	Pixel [Output Image]
0	0	0
0	1	1
1	0	1
1	1	0

Table 1. XOR-truth table

RESULTANT IMAGE WHERE DEFECT DETECTED:

Both the images are compared and the difference in the image is displayed in the resultant image. If there is no defect found then the resultant image is an empty black image. Thus the images are compared and the defect is detected and corrected by using this inspection technique.

V. HARDWARE MODULE

A. E-CAM JIL 2246

High quality webcam with features such as compatiblity, USB support, LED lights in low light, microphone.
STIPULATION OF **E-CAM JIL 2246**

- 300K pixels wih 20MP (interpolated).
- CMOS olor sensor of high resolution .
- Focus can be adjustable.
- USB 2.0 connectivity.
- Imaging distance is of 5cm to infinity.
- It has 30fps display frame rate.
- Supported video format is YUY2.
- OS-WIN XP/VISTA/ 7 systems.

Suitable driver is installed to take snaps of PCB images and processed. It automatically gets stored in the folder. When code is executed respective images are loaded for comaprison.

Figure 4. E-cam JIL 2246

V. SOFTWARE MODULE

OPEN SOURCE COMPUTER VISION

It is software framed under BCD license and so it is free for educational and commercial use. It has c, C++, java, python interfaces. It supports windows, android, linux, MAC os, iOS platforms. It focuses o real time based system performance and provides better computational efficiency. It has library files made up of c, c++ that has a merit of multicore processing.

Barkeley software distribution is framed for operating server OS. Machine learning is the main concept. The latest version of openCV is 3.4.

ANACONDA

Anaconda is distribution that is free and open source. Numerous amounts of data can be processed and computing can be made easier. It eases the work of managing the packages. It allows us to execute the task without using command line arguments.It's package manager is conda. The task of managing packages include, collecting software tools, configures, upgrades, automatically installs. Anaconda consists of spyder package.

SPYDER

It's cross platform for scientific programming. It is extendable using plugins. Spyder can be used with anaconda on windows with python. Python consoles are supported.

VII. RESULT &CONCLUSION

As a result, PCB defect area is recognized for even mini sized error. In present scenario, PCB are essential component of many electrical devices today. There are numerous opportunities for Printed circuit board failure issues to arise. Quality checking of printed circuit board is a rigid role. Visual inspection manually produces mistakes and manpower is required which requires high cost. This affects timely delivery of printed circuit board products. These things can be overcome by implementing cost efficient and time efficient method by means of simple and compact Printed circuit board defect detection systems. From this it is concluded that the design system is very useful and affordable by industries to produce 100% quality printed circuit boards Orientations must be same in case of processing this code. In future this can be resolved. Lighting effect can varied to increase efficiency.

PROJECT RESULT SNAPSHOT

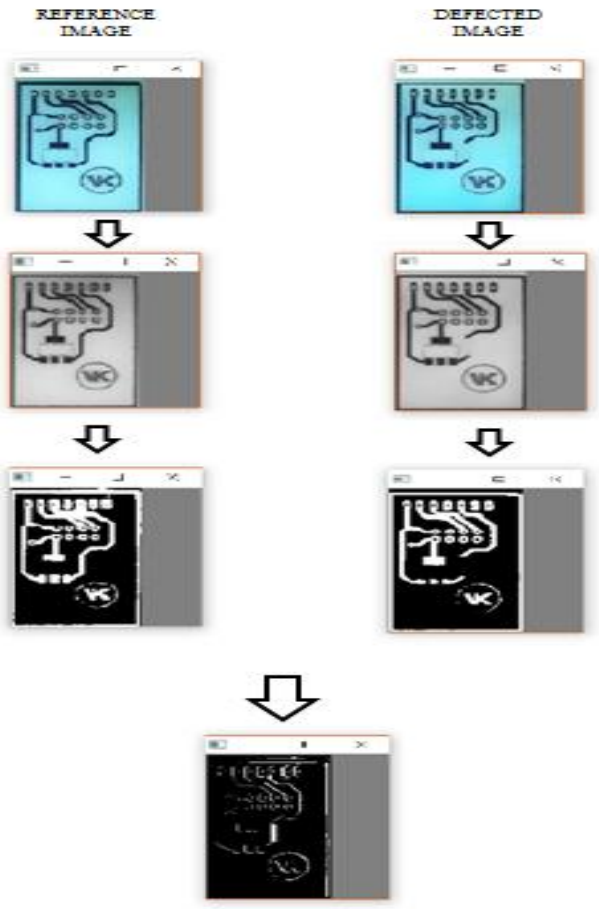

Figure 5. Result

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