Printed Circuit Board Detect and Component Recognition using Convolution Neural Network: A Review

Sonal Dattatray Gaikwad[1], A.G.Patil[2]

[1]PG Scholar, Department of E & Tc Engineering, PVPIT Budhgaon, Sangli, Maharashtra, India
[2]Professor, Dept. of E & Tc Engineering, PVPIT Budhgaon, Sangli, Maharashtra, India

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Abstract – *This paper introduce us printed circuit board detect and component recognition using convolution neural network .For this we are using image processing technique using MATLAB for new implementation with this we can localize defects of the PCB component, the component recognition classifier is developed by simple convolution neural network.. Since training convolution neural network from scratch is costly hence instead of pre trained model we use transfer learning. Here we are going to detect PCB faults and wrong mounting of components.*

Key Words: **Image Processing, Printed circuit board, Transfer learning, convolution neural network, precision**

1. INTRODUCTION

Every electronics company has an important element which is a printed circuit board. Now the companies are became fully automized so detection of faults in PCB should also be automatic that's why we are implementing a convolution network which will help us to detect the wrong paths of PCB by comparing it with pre determined PCB model. For PCB image reorganization neural network process is used. Now for the detection of components PCB component classifier is used this will help us to classify different elements on PCB by comparing Result with dummy board we can find out the fault.

According to [1] template matching approach is used to detect the PCB components. Another PCB detection using OPENCV with image subtraction methods is done by [2].from this existing detection frameworks, it can be inferred that is algorithm is limited to detect only a specific type of defects. With that being said, recently convolution neural network (CNN) has achieved excellent performance on machine vision tasks, particularly image recognition problems [3] [4].

These experiments are divided into two major phase which are optimization phase an experimentation Phase. Failure with a mapping while training with original images, it was a first experiment. They decide to enlarge the defects in the image by cropping the missing register defects out of the image and then resizing it to pixels it was there second experiment [6].

In PCB manufacturing the etching process is very difficult in this it will go in peeling process in peeling the copper layout get vanished so that to find out the defect is found.

1.2 Literature survey:

In this automatic detection of printed circuit board this is a method which is used to reduce human errors which are occurred by human mistake which will be fast and gives accurate results. These results are further classified into various formats.

It is very important to trace the wrong paths based on these study PCB defects can only exist in certain groups so if we use different image processing algorithms we can improve segmentation of image this project mainly include the testing image of single layer grayscale and computer generated PCB [7].

The for detect detection and classification of electronics circuit board by extracting key points without reference images to distinguish problematic defect, such as disconnection from non defect, dust in the manufacturing process. The cropped images are used as input to CNN. The effectiveness of this method is confirmed through a detection experiment using actual electronic circuit board images containing defect by comparing it with previous image [8].

In this work we are introducing region proposals that shares full image convolution features with the detection network thus enabling nearly cost free region proposals. The RPN (Region Proposer Network) and fast R-CNN into a single network by sharing there convolution features using the recently popular terminology of a neural networks with attention mechanisms, the RPN component tells the unified network where to look. [9]

A method for training CNN based object class detectors directly using mean average precision as the training loss, in a truly end to end fashion that includes non maximum suppression at training time. This contrast with the traditional approach of training a CNN for a window classification loss, then applying non maximum suppression only at test time, when mean average precision is used the evaluation metric in place of classification accuracy. However mean average precision following non maximum suppression forms a piecewise-constant structure loss over thousands of windows, with gradients that do not convey useful information for gradient descent [10].

2. Related Work

A. Block Diagram

Block Diagram for detecting defects and component recognition is done by using Convolution Neural Network.

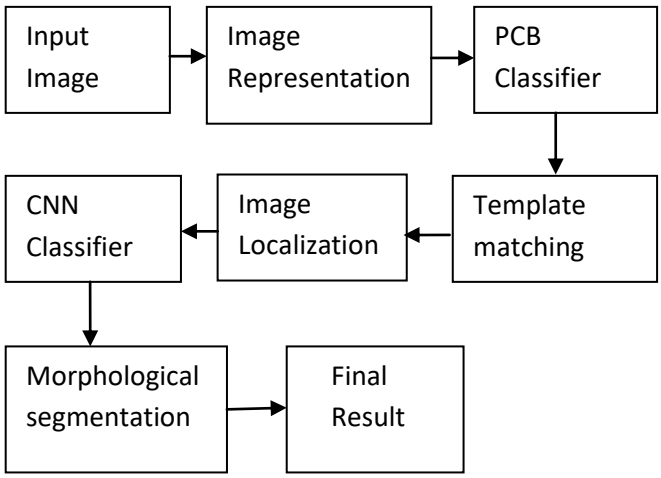

Fig-1: Block diagram of defects and components reorganization in PCB using CNN

In PCB detection firstly we can take an image from input data which is already taken from the PCB from which fault is to be find out .The captured image have same angle and scale. That captured image have to go from image representation is done by converting image into binary form.

PCB Classifier:

This system is mainly developed to distinguish different PCB components .For public use there is PCB dataset is not available so that we are going to use a dummy dataset for PCB.

Template Matching:

The components which are distinguished from PCB classifier they are recognized by using template matching. This is mainly used to match the original image with captured image.

Image Localization:

Its is mainly used to find out the actual image which is converted into binary form after thresholding it we can find out the exact place of the image

CNN Classifier:

This classifier has hierarchical model which gives highest accuracy for image classification and recognition

Morphological Segmentation:

With the help of 2D and 3D array gray scale image is captured and by using different morphological operations are performed and the image is breaked into segments and segmentation is carried out.

After this process the original image is compared and by creating these different operations on a PCB image we can found the wrong mounted components and PCB faulted paths.

2.1 Methodology

In this first part if the project which is to create a system that can classify different components on the PCB by PCB component Classifier. Since there no data set is available so data sets for PCB board are taken from dummy PCB images it is mainly used to tune newly generated PCB inspection machines. They covers most of the defects that could arises in real would.

Data augmentation is used to increase the variety of data in order avoid a over fitting issues. By using this captured image is rotated in various angles such as 90,180,270&360 degrees.

The final layer of the pre trained model cancelled and replaced with the new custom layer consisting of the desired components that are to be recognized.

By using the testing images the accuracy of the model is taken. Several parameters are configured prior to the training and it affects the performance of the output model. For this project, both the training batch size and validation batch size are set to some value.

Now at the second stage the main focus is to detect the defects on the PCB board like an object, and then localize and classify them at the same time .The data used for PCB defect localization is the same as the data used in component classification part which is the PCB images provided by the data set. Only the missing register defect is focused.

So here we can found the component recognition and fault is detected. To prepare the dataset, the full PCB images are cropped into a number of parts so it has the suitable size.

There are different methods for data augmentation such as cropping; rotation and padding are performed to improve the localization and classification performance of the model [6].

The training is performed using transfer learning on the pretrained model faster R-CNN inception. After performing training, final result is done using testing datasets while the mean average precision (mAP) is used to evaluate the performance of the system [10].

3. CONCLUSIONS

Since there is a huge demand for the atomization in the every electronics companies so to detect the faults in PCB with the help of human beings becomes time consuming. Because of large demand of PCB in industry to detect the error on the PCB it becomes very important to create an error free system so by using this method We can easily find out the defects in the PCB paths and also we can find rather the component placed Is in right position or not. For this we are using some dummy PCB models it is done by using vitrox retrained model the faulty path and component us recognized.

REFERENCES

[1] Crispin AJ, Rankov V. Automated inspection of PCB components using a genetic algorithm template-matching approach. International Journal of Advanced Manufacturing Technology. 35(3-4), 293-300(2007).

[2] Raihan F, Ce W.PCB Defects Detection USING OPENCV with Image Subtraction Method. 2017 International Conference on Information Management and Technology (ICIMTech). , 204-209(2017).

[3] Hosseini H, Xiao B, Jaiswal M, Poovendran R. On the Limitation of Convolutional Neural Recognizing Negative Image.2017 16th IEEE International Conference on Machine Learning and Applications (ICMLA).,352-358(2017).

[4] Tao X, Wang Z, Zhang Z, et al. Wire Defect Recognition of Spring-Wire Socket Using Multitask Convolutional Neural Networks. IEEE Transaction on Components, Packaging and Manufacturing Technology, 8(4), 689-698(2018).

[5] PCB defect detection based on pattern matching and segmentation algorithm. International journal of advanced research Computer and Communication Engineering (2014).

[6] Defects and Component and Recognition in Printed Circuit Boards Using Convolutional Neural Network.

[7] Malge PS. PCB Defect Detection, Classification and Localization using Mathematical Morphology ad Image Processing Tools. International Journal of Computer Applications. 87(9), 40-45(2014).

[8] Defect Detection and Classification of Electronic Circuit Boards Using Key point Extraction and CNN Features Yohei Takada, Tokiko Shiina, Hiroyasu Usami, Yuji Iwahori [2017].

[9] Ren S, He K, Girshick R, Sun J. Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks. IEEE Transaction on pattern Analysis and Machine Intelligence. 39(6), 1137-1149(2017).

[10] Henderson P, Ferrai V. End- to- end training of object class detectors for mean average precision. In: Computer Vision—ACCV 2016, Springer. Cham. 198-213(2017).

[11] Uijlings JRR, Van De Sande KEA, Gevers T, Smeulders AWM. Selective Search for Object Recognition. International Journal of Computer Vision. 104(2), 154–171 (2012).

[12] Girshick R, Donahue J, Darrell T, Malik J. Rich feature hierarchies for accurate objectdetection and semantic segmentation. 2014 IEEE Conference on Computer Vision and Pattern Recognition. , 580–587 (2014).

[13] S. H. Indera Putera and Z. Ibrahim „Printed Circuit Board Defect Detection Using Mathematical Morphology and MATLAB Image Processing Tools", ICINT 2010, Shanghai, China, 2010.

[14] He K, Zhang X, Ren S, Sun J. Deep residual learning for image Recognition. 2016 IEEEConference on Computer Vision and Pattern Recognition (CVPR)., 770–778 (2016).

[15] He K, Zhang X, Ren S, Sun J. Deep residual learning for image Recognition. 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)., 770–778 (2016).

[16]D.B.Anitha, Mahesh R A survey on Defect detection in Bare PCB and assemble PCB using image processing techniques. In: 2017 International conference on wireless communication, signal processing and networking(WiSPENT);39-43(2017)