

To,
IITD-AIA Foundation of Smart Manufacturing

Subject: Weekly Progress Report for Week 1

Dear sir,

Following is the required progress report to the best of my knowledge considering relevant topics to be covered.

What's happening this week:

- OpenCV advance implementation
- Fault analysis
- Classification - identifying different types of defects in PCBs
- Binary image Morphology and Image subtraction
- Sobel Edge Detection and Canny Edge Detection

My understanding of INTP22-ML-3: Computer Vision to detect defects in PCB

Scope:

In the PCB manufacturing industry, one of the most important aspects of production is quality checking. PCB boards go through lots of production processes from panel cutting to laminating and one single defect in a board will make the entire board become obsolete. With the rise of electronic appliance demands every day, the demand for higher quality components is rising. With the high price tag of commercial automated optical inspection (AOI), lots of manufacturers are not able to do an automated inspection

Solution:

This is where Computer Vision can provide an alternative for commercial AOI to assist small scale manufacturers to do an automated inspection.

Approach:

Image Subtraction and Blob detection enable users to easily find numerous visual defects in PCBs, especially with a complex method. By dissecting pictures and pointing out the differences in the output image, PCBs can be inspected quickly to find out the defective parts.

Weekly Progress:

June 01:

INTP allocation - Computer vision to detect defects in PCB.

- Going through open-source implementations of the problem
- Discovering resources and materials that can be helpful
- Searching for relevant dataset
- Learning OpenCV

June 02:

Searching for resources across the internet. It was quite difficult because the practical industrial implementation of OpenCV is limited to prototyping only.

- Went through OpenCV tutorials
- Computer Vision and Computer Photography
- Introduction to OCR and Face Recognition
- Vision-based interaction
 - Introduction to images as a function
 - MATLAB implication
 - Loading and displaying Images

June 03:

Learnt a lot about Numpy and Pandas libraries in greater detail. Implemented them to some extent too.

Numpy

- Learnt about how arrays can be represented as matrices
- Images are nothing but matrices of tuples
- These tuples are often just the values of RGB of that particular pixel
- Significance and relevance of arrays and numbers in images and their functions
- Images can be represented as surfaces, hence, edges have sharp gradient descent

Pandas

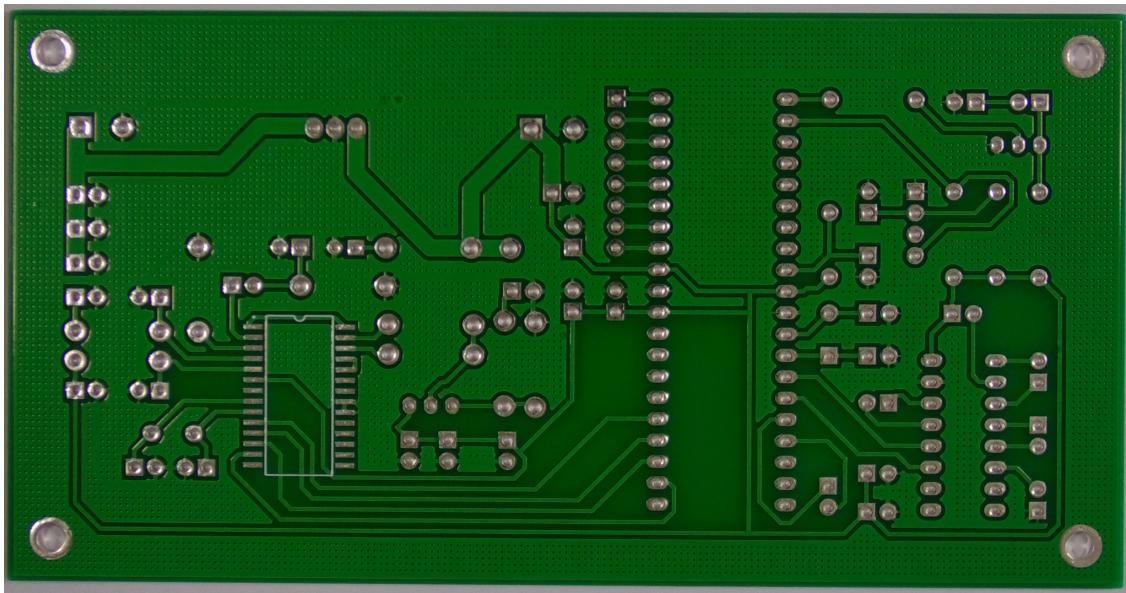
- I still haven't figured out the implementation of Pandas here, however, will go through the documentation and try to understand which kind of datasets can be used to load into the model, what operations can be done on it, and so on.

Got to learn an entirely new perspective of how we pursue images. How humans see images and how computers see them. Makes me wonder how brilliant ordinary cameras are! It is fascinating to learn about colours, RGB and GRAY scales.

June 04:

Referring to research papers. How these authors have implemented or theorized the concept of PCB inspection using OpenCV and industrial limitations.

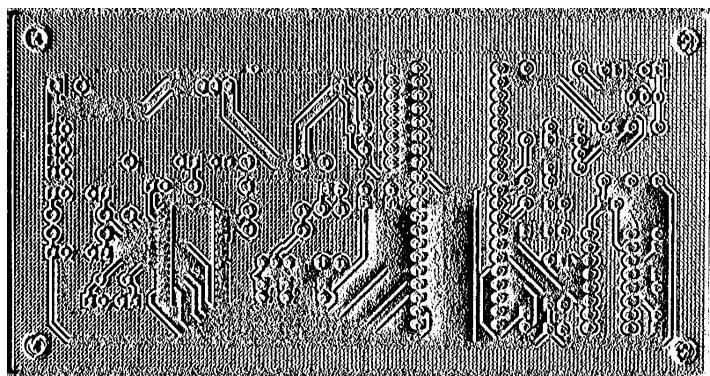
Tried to implement certain OpenCV Pipeline on a real dataset. Was pretty impressed by the results. Code has been updated on [keivalya/FSM-INT-2022: INTP2022-ML-3 \(github.com\)](https://github.com/keivalya/FSM-INT-2022)



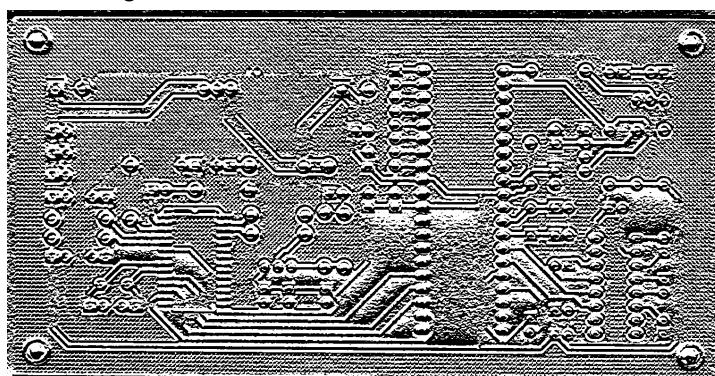
Edges are characterized by sudden changes in pixel intensity.

Hence, I use the following methods

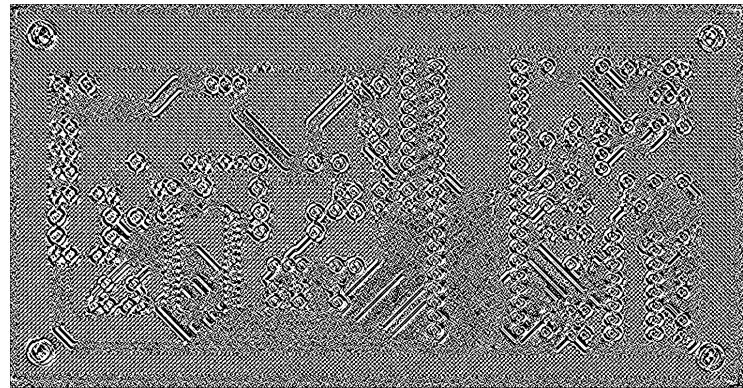
- Sobel Edge Detection Algorithm
 - Sobel Edge Detection on the X axis



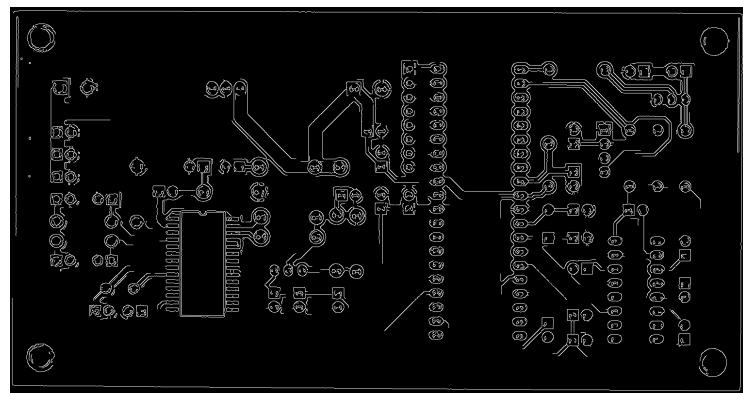
- Sobel Edge Detection on the X axis



- Combined X and Y Sobel Edge Detection



- Canny Edge Detection Algorithm



References:

1. Raihan, F., & Ce, W. (2017). PCB defect detection USING OPENCV with image subtraction method. 2017 International Conference on Information Management and Technology (ICIMTech). doi:10.1109/icimtech.2017.8273538