FSM Internship Project 2022

Problem statement: INTP22-ML-3: Computer Vision to detect defects in PCB.
Description: To use computer vision to detect defects in PCB. The model should be deployed on the cloud with a pipeline that would allow the image to be uploaded and inference to be done on the cloud.
Software: Python3, PyTorch, Tensorflow, Scikit-Learn, Numpy, Pandas, OpenCV and Flask
Resources: Any Cloud hosting service to host the website
Hardware Requirement: High Definition USB Camera
Mentor: Devesh Tarasia

Introduction:

Printed circuit boards are used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. They are used to save space, organize, reduce errors and mainly **avoid failure**. Hence, it is very important for PCB manufacturers to reduce the various kinds of **defects** through effective **inspection** in order to ensure the production quality. In recent years, the digital transformation has revolutionized the field of **computer vision** and has played a major role in risk monitoring and mitigation. Hence computer vision is majorly used to detect the defects on the PCB. The defective PCB can be recycled or repaired based on the kind of defect it has which also reduces the wastage of components and materials.

Related works:

Recent works show that the PCB defect detection techniques using computer vision are generally classified into two groups, which is image subtraction and feature extraction. **Image subtraction** is the simplest approach to PCB inspection. The PCB to be inspected is compared with the reference image and the subtracted image shows defects. The disadvantage of image subtraction technique is that it is not able to generate comprehensive details of the different kinds of defects that have occurred on the PCB, whereas the **feature extraction** method can be trained to detect different kinds of defects and can be generalized for all types of PCB. In [1] the performance of SSD (Single Shot MultiBox Detector) and FPN (Feature Pyramid Network) on the two standard PCB defect dataset are found to give excellent results. Similarly in [2] shows the comparison between YOLO (You Only Look Once), SSD and Faster R-CNN on DeepPCB[3] dataset. From this it can be concluded that the performance of the feature extraction method is more than acceptable to implement PCB defect detection.

Datasets:

1) PCB Dataset [3]: This is a public synthetic PCB dataset containing 1386 images with 6 kinds of defects (missing hole, mouse bite, open circuit, short, spur, spurious copper) for the use of detection, classification and registration tasks.
2) DeepPCB Dataset [4]: a dataset contains 1,500 image pairs, each of which consists of a defect-free template image and an aligned tested image with annotations including positions of 6 most common types of PCB defects: open, short, mouse bite, spur, pin hole and spurious copper.

Objectives:

1) To determine the different algorithms to implement for PCB defect detection based on performance on standard datasets like COCO, Pascal, etc
2) To train at least 2 models for PCB defect detection
3) To evaluate the performance of the model and tune hyperparameters to improve model performance
4) To build a web application using flask to upload an image of a PCB and detect defects in the image using the trained models

Deliverables:

1) PCB defect detection models trained using PCB dataset [3]
2) Implementation of the trained model on real-time image data
3) Web application using flask to detect pcb defects by uploading image
4) Report of the project

Project Timeline:

Phase	Week-1 June 1-5	Week-2 June 6 -12	Week-3 June 13 - 19	Week-4 June 20 - 26	Week-5 June 27 - July 3	Week-6 July 4 - 10	Week-7 July 11 - 17	Week-8 July 18 - 24	Final Week July 25 - 31
Understanding data and Exploratory Data Analysis									
Model Building and Training									
Model Hyperparameter tuning									
Model comparison and testing									
Model Deployment									

References:

[1] X. Wu, Y. Ge, Q. Zhang and D. Zhang, "PCB Defect Detection Using Deep Learning Methods," 2021 IEEE 24th International Conference on Computer Supported Cooperative Work in Design (CSCWD), 2021, pp. 873-876, doi: 10.1109/CSCWD49262.2021.9437846.

[2] ONLINE PCB DEFECT DETECTOR ON A NEW PCB DEFECT DATASET

[3] DeepPCB

[4] PCB Defects Dataset