

Printed Circuit Board Defect Detection Using YOLOv12-s

Pooja R Kabbinakantimath

Department of Electronics and Communication Engineering, KLE Technological University,
Hubballi, Karnataka, India

Shrushti Torgal

Department of Electronics and Communication Engineering, KLE Technological University,
Hubballi, Karnataka, India

Brundha Korishettar

Department of Electronics and Communication Engineering, KLE Technological University,
Hubballi, Karnataka, India

Vidyashri Math

Department of Electronics and Communication Engineering, KLE Technological University,
Hubballi, Karnataka, India

Abstract:

In this paper, we propose YOLOv12-s based framework for automatic defect detection on printed circuit boards. Printed circuit boards have a high density of components, fine traces, and low-contrast defects, making it challenging to detect them accurately using both manual and traditional automated approaches. The proposed framework integrates multi-scale feature extraction with an Area Attention (A^2) mechanism to focus on areas where defects tend to happen. Furthermore, a label synchronization approach is used to address inconsistencies in the training set to enhance model learning. The proposed model is tested on six types of defects: Open, Short, Mousebite, Spur, Spurious Copper and Missing Hole. The model has a light architecture, allowing for fast inference and real-time processing in industrial settings. An ablation study is also conducted to further confirm the effectiveness of the Area Attention module and label synchronization strategy in improving overall model performance. The proposed method is tested on the DeepPCB dataset. The results show that the proposed method achieves a mAP@50 of 98.61%, ensuring accurate detection of small and overlapping defects with real-time processing capability for industrial PCB inspection.

Keywords:

Printed circuit board defect detection, yolov12-s, deep learning, area attention, industrial inspection.