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Deep Learning for Fabric Defect Detection

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Introduction

Defect detection in fabric production is vital for quality control purposes. Identifying defects manually is tedious and time-consuming, and can cause a 45 - 65% reduction in the selling price of fabrics [1]. Past research in this domain includes statistical approaches, spectral analysis and model-based or learning approaches [2, 3]. Deep learning techniques, like CNN-based and transformer-based models, have exhibited strong performance in object detection tasks [4]. This project aims to fine-tune two such models, YOLOv8 and RT-DETR, for fabric defect detection and create an ensemble model to further optimise detection performance on 19 different fabric types from the ZJU-Leaper Dataset [5].

Approach

Finetune YOLOv8 and RT-DETR on subset of ZJU-Leaper Dataset

Implement Modified StackBox Ensemble Model

Test Meta-Models and Select Optimal Configurations

Compare with Other Models and Ensemble Methods

Results

The optimal Modified StackBox Ensemble model consists of finetuned YOLOv8 and RT-DETR base models, and a Support Vector Machine Regression meta-model. It outperforms other ensemble techniques including Non-Max Suppression (NMS), Soft-NMS, and Weighted Boxes Fusion in terms of Average Precision. It also shows better defect localisation performance compared to Cascade-RNN, Faster-RCNN and RetinaNet models.

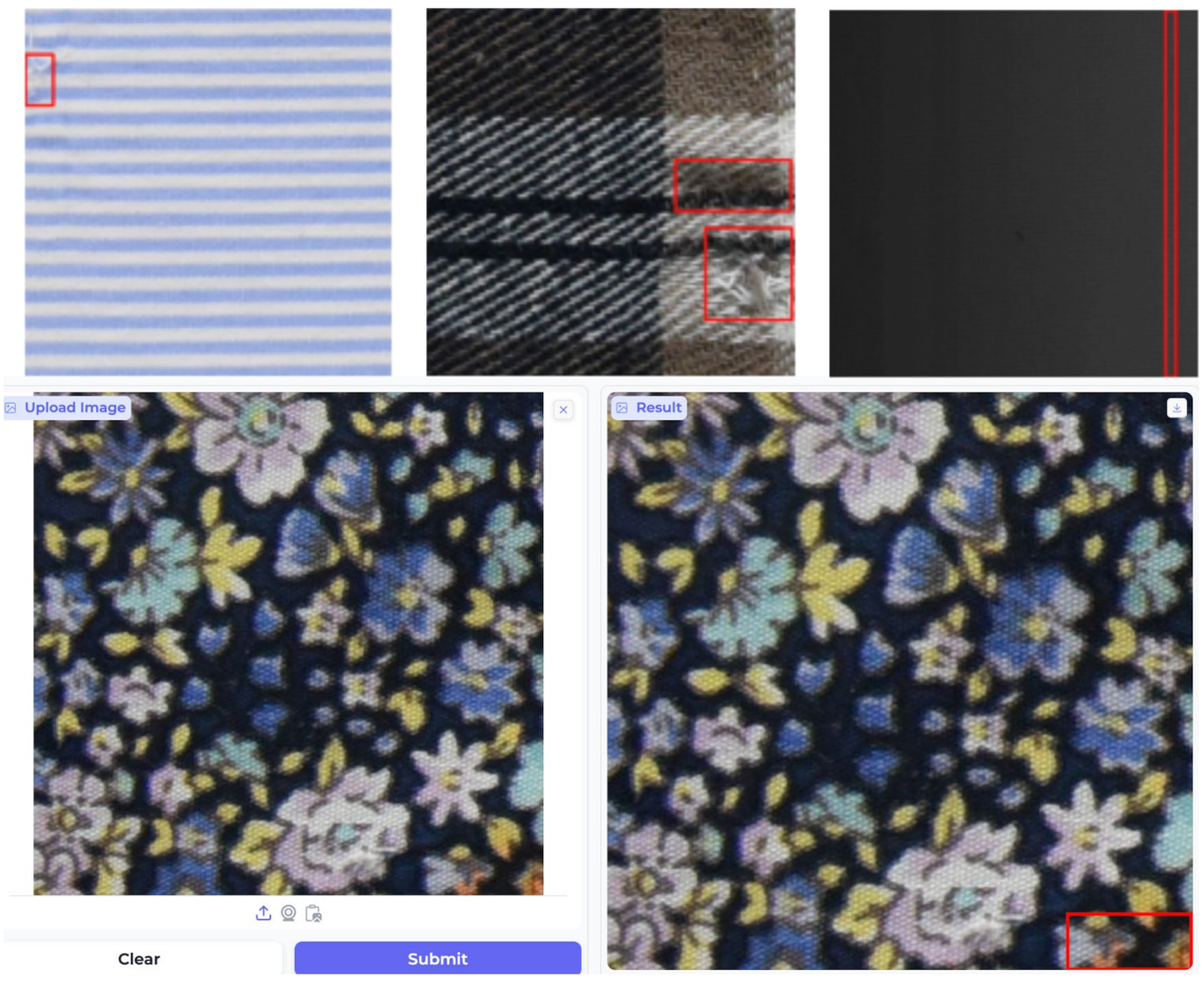

Fig 1: Modified StackBox Ensemble Model Detection Results

Models	Average Precision
Finetuned YOLOv8	0.714
Finetuned RT-DETR	0.759
Modified StackBox Ensemble Model	0.783

Table 1: Test Set Results

References:

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