ABSTRAK

Proses inspeksi kualitas pada produk *stamping* baja masih banyak dilakukan secara manual sehingga rentan terhadap kesalahan akibat faktor kelelahan, subjektivitas operator, dan keterbatasan dalam mendeteksi cacat berukuran kecil. Penelitian ini bertujuan untuk mengimplementasikan sistem inspeksi cacat produk *stamping* baja secara otomatis menggunakan metode *You Only Look Once Version 8* (YOLOv8) yang terintegrasi dengan sistem berbasis *web*. Metode penelitian meliputi akuisisi citra produk *stamping* baja, anotasi dan *pre-processing* dataset menggunakan Roboflow, pelatihan model YOLOv8, implementasi model ke dalam aplikasi berbasis *web* menggunakan *Flask*, serta evaluasi kinerja model dan sistem. Dataset yang digunakan terdiri atas **518 citra produk**, yaitu **176 citra Part OK** dan **342 citra Part NG**, dengan tiga kelas cacat yang menjadi fokus deteksi, yaitu *black spot*, *dent*, dan *scratch*. Hasil anotasi menghasilkan sebanyak **2.173 instances** objek cacat. Berdasarkan hasil evaluasi terhadap data validasi, model YOLOv8n memperoleh nilai *Precision* sebesar **70,0%**, *Recall* sebesar **64,7%**, *mAP@50* sebesar **63,3%**, dan *mAP@50–95* sebesar **25,1%**. Kelas *dent* memperoleh performa terbaik dengan nilai *mAP@50* sebesar **81,3%**, diikuti *scratch* sebesar **66,7%**, sedangkan *black spot* memperoleh nilai *mAP@50* sebesar **41,9%**. Hasil implementasi menunjukkan bahwa sistem mampu melakukan deteksi cacat secara *real-time* menggunakan kamera, menampilkan *bounding box*, label kelas, nilai *confidence*, serta status produk **OK** atau **NG** melalui antarmuka berbasis *web*. Pengujian implementasi menunjukkan tingkat keberhasilan sebesar **100%** pada produk **OK**, **90%** pada deteksi *dent*, **85%** pada deteksi *scratch*, dan **80%** pada deteksi *black spot**. Sistem yang dikembangkan dapat digunakan sebagai alat bantu bagi operator *Quality Control* (QC) dalam melakukan inspeksi kualitas produk secara lebih cepat, konsisten, dan efisien.

Kata Kunci: *computer vision*, *deep learning*, inspeksi cacat, *stamping* baja, web, YOLOv8

ABSTRACT

*The quality inspection process for steel stamping products is still widely performed manually, making it prone to errors caused by operator fatigue, subjective judgment, and limitations in detecting small defects. This study aims to implement an automated defect inspection system for steel stamping products using the **You Only Look Once Version 8 (YOLOv8)** method integrated with a web-based system. The research methodology includes image acquisition of steel stamping products, dataset annotation and pre-processing using Roboflow, YOLOv8 model training, implementation of the trained model into a web-based application using Flask, and evaluation of both model and system performance. The dataset consisted of **518 product images**, including **176 OK-part images** and **342 NG-part images**, with three defect classes as the detection targets, namely **black spot, dent,** and **scratch**. The annotation process produced a total of **2,173 defect instances**. Based on the evaluation results on the validation data, the YOLOv8n model achieved a **Precision** of **70.0%**, **Recall** of **64.7%**, **mAP@50** of **63.3%**, and **mAP@50–95** of **25.1%**. The **dent** class achieved the highest performance with an **mAP@50** of **81.3%**, followed by **scratch** at **66.7%**, while **black spot** achieved **41.9%**. The implementation results show that the system is capable of performing real-time defect detection using a camera and displaying bounding boxes, defect class labels, confidence scores, and product status (**OK** or **NG**) through a web-based interface. Implementation testing showed success rates of **100%** for **OK** products, **90%** for **dent** detection, **85%** for **scratch** detection, and **80%** for **black spot** detection. The developed system can serve as a supporting tool for Quality Control (QC) operators to perform product quality inspections more quickly, consistently, and efficiently.*

***Keyword**: computer vision, deep learning, defect inspection, steel stamping, web, YOLOv8*

KARAWANG