ABSTRAK

PT Aman Indah Makmur merupakan salah satu perusahaan yang bergerak di bidang produksi popok dan produk higienis lainnya. Seluruh proses produksi dilakukan secara otomasi penuh dengan kecepatan operasional 150–200 *pieces per minute* (ppm) atau setara 3–4 unit per detik. Kecepatan tersebut menyebabkan sistem inspeksi eksisting tidak mampu memeriksa secara konsisten, sehingga penelitian ini bertujuan untuk merancang sistem inspeksi cacat produk popok secara *real-time* berbasis *You Only Look Once version* 8 (YOLOv8) dengan objek penelitian berupa 14 jenis cacat visual yang ditetapkan sebagai *Critical to Quality* (CTQ).

Penelitian ini menggunakan metode YOLOv8 untuk mendeteksi dan mengklasifikasikan cacat pada citra produk popok, dimulai dari *labeling* menggunakan Roboflow, augmentasi data dengan faktor 3× per kelas, hingga *training model* selama 150 *epoch*. Model terbaik selanjutnya diimplementasikan pada sistem *dashboard* berbasis *framework* Flask yang menampilkan *live feed* deteksi, *counter* produk, histori inspeksi, dan fitur ekspor laporan ke Excel. Analisis kelayakan biaya juga dilakukan menggunakan *Net Present Value* (NPV), *Internal Rate of Return* (IRR), *Benefit Cost Ratio* (B/C Ratio), dan *Payback Period* untuk mengevaluasi kelayakan investasi sistem usulan.

Hasil *training* menunjukkan model terbaik pada epoch ke-117 dengan mAP50-95 sebesar 0,9641. Pengujian statis menghasilkan *accuracy* 97,80%, *precision* 98,23%, *recall* 99,55%, dan F1-*score* 98,89%, sedangkan pengujian *real-time* selama 11,08 jam terhadap 138.306 unit produk menghasilkan *accuracy* 99,79%, *precision* 98,12%, *recall* 98,54%, dan F1-*score* 98,33% tanpa *frame drop*. Sistem usulan terbukti unggul secara signifikan dibandingkan sistem eksisting (uji *Wilcoxon signed-rank*, p-value < 0,001) dan layak secara finansial dengan NPV Rp394.967.457, IRR 176,36%, B/C Ratio 3,20, serta Payback Period sekitar 7 bulan.

Kata kunci: YOLOv8, inspeksi cacat, *computer vision*, *real-time*, kualitas produk, popok, kelayakan investasi

ABSTRACT

PT Aman Indah Makmur is a company engaged in the production of diapers and other hygiene products. The entire production process is carried out through full automation with an operational speed of 150–200 pieces per minute (ppm), or equivalent to 3–4 units per second. This speed causes the existing inspection system to be unable to perform consistent checks, so this research aims to design a real-time diaper product defect inspection system based on You Only Look Once version 8 (YOLOv8), with the research object consisting of 14 types of visual defects established as Critical to Quality (CTQ).

This research employs the YOLOv8 method to detect and classify defects in diaper product images, beginning with labeling using Roboflow, data augmentation with a 3× factor per class, and model training for 150 epochs. The best model was subsequently implemented into a dashboard system based on the Flask framework, which displays a live detection feed, product counter, inspection history, and a report export feature to Excel. A cost feasibility analysis was also conducted using Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (B/C Ratio), and Payback Period to evaluate the investment feasibility of the proposed system.

The training results show that the best model was obtained at epoch 117 with an mAP50-95 of 0.9641. Static testing yielded an accuracy of 97.80%, precision of 98.23%, recall of 99.55%, and F1-score of 98.89%, while *real-time* testing over 11.08 hours on 138,306 product units yielded an accuracy of 99.79%, precision of 98.12%, recall of 98.54%, and F1-score of 98.33% without any frame drops. The proposed system was proven to significantly outperform the existing system (Wilcoxon signed-rank test, p-value < 0.001) and was found to be financially feasible, with an NPV of Rp394,967,457, an IRR of 176.36%, a B/C Ratio of 3.20, and a Payback Period of approximately 7 months.

Keyword: YOLOv8, defect inspection, computer vision, real-time, product quality, diaper, investment feasibility