ABSTRAK

Inspeksi botol *polyethylene terephthalate* (PET) pada skala Usaha Mikro, Kecil, dan Menengah masih banyak dilakukan secara manual sehingga konsistensi pemeriksaan berpotensi menurun, terutama dalam mendeteksi deformasi fisik berupa penyok dan meleleh. Penelitian ini bertujuan merancang dan mengimplementasikan sistem penyortiran botol PET otomatis berbasis *computer vision* menggunakan YOLOv8. Penelitian ini berasumsi bahwa deformasi botol dapat dibedakan melalui karakteristik visual pada kondisi akuisisi citra yang terkendali, dengan hipotesis bahwa integrasi YOLOv8, konveyor, dan aktuator mampu melakukan deteksi serta penyortiran secara *real-time*. Tahapan penelitian meliputi studi literatur, identifikasi masalah, analisis kebutuhan, perancangan, implementasi, pengujian, dan analisis hasil. Sistem menggunakan webcam sebagai perangkat akuisisi citra, laptop sebagai unit pemrosesan, Arduino Mega 2560 sebagai pengendali, motor DC sebagai penggerak konveyor, dan motor servo sebagai aktuator penyortiran. Hasil pengujian menunjukkan bahwa model mencapai akurasi 88,19%, kecepatan rata-rata 13,25 FPS, dan waktu pemrosesan 0,0787 detik per frame. Konveyor bekerja paling stabil pada PWM 70, sedangkan motor servo memiliki waktu respons rata-rata 0,326 detik. Pengujian intensitas cahaya menghasilkan keberhasilan klasifikasi 100%, pengujian jarak kamera 65,26%, dan pengujian integrasi sistem 86,67%. Kondisi operasional terbaik diperoleh pada jarak kamera 40 cm dan jarak antar botol 6 cm. Dengan demikian, sistem mampu mendeteksi, mengklasifikasikan, mencatat, dan menyortir botol PET secara otomatis, meskipun performa klasifikasi masih perlu ditingkatkan pada objek dengan karakteristik visual yang serupa.

Kata kunci: botol PET, *computer vision*, deformasi fisik, penyortiran otomatis, YOLOv8

ABSTRACT

The inspection of polyethylene terephthalate (PET) bottles in Micro, Small, and Medium Enterprises is still commonly performed manually, which may reduce inspection consistency, particularly in identifying physical deformations such as dents and heat-induced damage. This study aims to design and implement an automatic PET bottle sorting system based on computer vision using YOLOv8. The study assumes that bottle deformation can be distinguished through visual characteristics under controlled image-acquisition conditions, with the hypothesis that the integration of YOLOv8, a conveyor, and an actuator can perform real-time detection and sorting. The research stages included literature review, problem identification, requirements analysis, system design, implementation, testing, and result analysis. The system used a webcam for image acquisition, a laptop as the processing unit, an Arduino Mega 2560 as the controller, a DC motor to drive the conveyor, and a servo motor as the sorting actuator. The results showed that the model achieved an accuracy of 88.19%, an average processing speed of 13.25 FPS, and a processing time of 0.0787 seconds per frame. The conveyor operated most stably at PWM 70, while the servo motor had an average response time of 0.326 seconds. The lighting-intensity test achieved a 100% classification success rate, the camera-distance test achieved 65.26%, and the system integration test achieved 86.67%. The optimal operating conditions were obtained at a camera distance of 40 cm and an inter-bottle spacing of 6 cm. Therefore, the system can automatically detect, classify, count, and sort PET bottles, although its classification performance should be improved for objects with similar visual characteristics.

Keywords: *automatic sorting, computer vision, physical deformation, PET bottles, YOLOv8*