DESIGNING AND DEVELOPING A PACKAGED BOTTLE WASTE DETECTION AND SORTING SYSTEM USING WEBCAM AND YOLO V-11 METHOD

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ABSTRACT

The improper sorting of beverage bottle waste poses significant environmental challenges, as commonly encountered materials—such as plastic and aluminum—are not easily biodegradable. This research aims to design and develop an automated system capable of detecting and classifying types of packaged bottle waste with high accuracy. The system utilizes the You Only Look Once version 11 (YOLO v11) method for object detection. The dataset comprises labeled images of various beverage containers, categorized by material type. Model training was conducted using GPU acceleration via Google Colaboratory to optimize training time. Testing results reveal that the system achieved an overall detection and classification accuracy of 97% by the 200th epoch. Specifically, the model reached a confidence level of 87% for aluminum cans and 84% for plastic bottles. Furthermore, the system integrates an automatic sorting mechanism powered by a servo motor, which demonstrated a 100% success rate over 30 sorting trials. This system shows strong potential for integration into vending machine concepts to enhance waste sorting efficiency and environmental sustainability.

Keywords: waste detection, packaged bottles, YOLO v11, deep learning, object classification.