Abstract

Detecting defects in green Arabica coffee beans is critical to maintaining quality and meeting international market demands. Traditional manual methods using hands and eyes for defect detection are prone to errors due to human subjectivity. To address these limitations, this study proposes an automated system leveraging the Large Selective Kernel Network (LSKNet) feature extraction backbone integrated with the Oriented (ORCNN) framework. Unlike prior approaches that rely on specialized equipment, the proposed system is designed for implementation in general environments, enabling high- resolution photography at various distances without the need for advanced imaging systems. This adaptability is critical in scenarios where objects may appear too small for conventional detection methods. The research focuses on identifying defects in green Arabica coffee beans, including three defect classes defined by the Indonesian National Standard (SNI): black beans (hitam), partially black beans (hitam-sebagian), and small coffee husk (kulit-kopi-kecil). Comparative experiments were conducted using YOLOv8 as a benchmark. Results demonstrate the superiority of the LSKNet-S configuration, which achieved the highest mean Average Precision score of 0.879, surpassing YOLOv8 and LSKNet-T variants. The proposed system not only excels in detecting small and clustered defects under diverse imaging conditions but also offers a scalable, cost-effective solution for coffee quality assurance. Furthermore, the system's flexibility allows for potential implementation as a smartphone application, enabling producers and farmers to perform on-the- go defect detection, further enhancing accessibility and usability across the supply chain.

Keywords: Green Arabica coffee beans, object detection, LSKNet, YOLOv8