

***Implementation of The Yolov11 Algorithm on Raspberry Pi for Detecting The Physical Condition of Cocoa Fruit (Theobroma cacao L.)***

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**ABSTRACT**

*Quality standardization of cocoa fruit (Theobroma cacao L.) during the harvest phase is currently still dominated by manual visual estimation, which is highly susceptible to variations in individual perception. This study aims to implement the YOLOv11n algorithm on a Raspberry Pi 5 device to detect the physical condition of cocoa fruit in real-time, classifying them into two categories, namely good and bad, based on visual characteristics such as color, texture, and fruit surface conditions. Data were collected through field observations and expert interviews at a cocoa plantation in Jember Regency, yielding 500 labeled images consisting of 250 images of good condition and 250 images of bad condition, alongside 30 unlabeled background images. The dataset was processed via the Roboflow platform through preprocessing, bounding box labeling, data augmentation, and a 70:20:10 dataset split ratio, expanding the total dataset after augmentation to 1,643 images. The model was trained using the Ultralytics architecture on the Google Colab platform for 100 epochs. Evaluation on the validation set yielded high performance metrics, including a precision value of 0.9869, a recall index of 0.9907, a mAP50 score of 0.9941, and a mAP50-95 achievement of 0.9501. Furthermore, real-time testing using a webcam on the Raspberry Pi 5 demonstrated a detection success rate of 80% across 10 testing scenarios. The research results demonstrate that YOLOv11n can be successfully deployed on edge devices to support objective and consistent physical condition detection of cocoa fruit.*

**Keywords:** *YOLOv11, Raspberry Pi, object detection, cocoa fruit, computer vision*