



UNDERGRADUATE THESIS

**COMPARATIVE ANALYSIS OF EFFICIENCY
AND ACCURACY OF U-NET ARCHITECTURE
WITH MOBILENETV2 ENCODER AND
ATTENTION GATE IN COFFEE LEAF RUST
DISEASE SEGMENTATION**

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2026**


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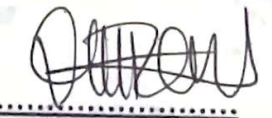
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ABSTRACT

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Thesis Title : Comparative Analysis of Efficiency and Accuracy of U-Net Architecture with MobilenetV2 Encoder and Attention Gate in Coffee Leaf Rust Disease Segmentation
Supervisor : 1. Dr. Faisal Muttaqin, S.Kom, M.T.
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This study presents a comparative analysis of segmentation accuracy and computational efficiency for Coffee Leaf Rust detection using four deep learning architectures: U-Net and Attention U-Net combined with VGG16 and MobileNetV2 encoders. The segmentation task classifies pixels into background, healthy leaf, and disease lesion to support precise disease severity quantification.

Using a curated dataset of 128 annotated image-mask pairs, the models were evaluated on lesion-focused segmentation metrics, including Intersection over Union (IoU), Dice Coefficient, Precision, and Recall. Computational efficiency was measured via parameter count and FLOPs, alongside practical validation using linear regression analysis against ground-truth disease severity values.

Results indicated that the Attention U-Net with VGG16 encoder achieved the highest accuracy, yielding an IoU of 0.7366 and the strongest regression for severity estimation ($R^2 = 0.7221$). Conversely, the MobileNetV2-based models offered substantially better computational efficiency, reducing the model size to under 1 million parameters. These findings demonstrate that while VGG16 excels in precision, the lightweight MobileNetV2 architecture provides a highly feasible, resource-efficient alternative for rapid field implementation.

Keywords: semantic segmentation, coffee leaf disease, U-Net, Attention U-Net, severity estimation, deep learning

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