

Aedes Mosquito Larvae Classification Using Swin Transformers

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Dengue fever is a major public health concern in Sri Lanka, where early identification of *Aedes aegypti* and *Aedes albopictus* larvae is essential for effective vector control. Manual larval identification is time-consuming, expertise-dependent, and often unreliable under field conditions. This study presents an automated deep learning approach for classifying mosquito larvae using Swin Transformer architectures. A dataset of 5,939 images was curated by combining images captured by the researchers with publicly available collections from platforms such as Mendeley, Kaggle, and Roboflow, and annotated into three classes: *Aedes aegypti*, *Aedes albopictus*, and non-*Aedes* (comprising other common mosquito genera). Images were pre-processed with augmentation techniques, and three Swin Transformer variants Swin-T, Swin-S, and Swin-B were fine-tuned using a customized Linear $\rightarrow$ ReLU $\rightarrow$ Dropout $\rightarrow$ Linear head, AdamW optimization, StepLR scheduling, and Label Smoothing Cross-Entropy. Dataset refinement, guided by Gradient-weighted Class Activation Mapping (Grad-CAM), enabled the removal of ambiguous samples. Swin-B achieved the highest accuracy of 96.86%, outperforming conventional convolutional neural network (CNN) models reported in the literature. The hierarchical shifted-window attention mechanism of Swin Transformers effectively captured fine-grained morphological features, including siphon shape, head structure, and thorax bristles, supporting reliable species-level differentiation. These findings demonstrate the potential of transformer-based models for dengue vector surveillance.

Keywords: *Aedes aegypti*, *Aedes albopictus*, deep learning, Swin Transformer, image classification