A Survey of Loss Functions for SegNet for Mosquito Breeding Site Detection

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In recent years, computer vision has witnessed significant advancements, revolutionizing various domains. A critical application we consider, especially in the context of Sri Lanka, is the surveillance of mosquito breeding sites and detection. Efficient and accurate identification of these sites plays a crucial role in effective mosquito vector control programs. SegNet is a deep neural network architecture, successfully applied to many semantic segmentation tasks, making it a compelling choice for mosquito breeding site detection. One of the key parameters which controls the performance of the SegNet is the loss function. Hence, this paper present a comprehensive study on selecting a suitable loss function for SegNet for stagnant water detection application, starting with a systematic empirical comparison of different loss functions. To achieve this objective, first, we created a custom drone image dataset. Using this dataset, we built and trained customized SegNet models using five well-known loss functions, namely Categorical cross-entropy, Binary cross-entropy, Focal Tversky loss, IoU loss, and Dice loss. During the training phase, the model underwent transfer learning-based domain adaptation. I.e. initially, the model was trained on a publicly available large water area dataset, comprising 1,052 RGB images. Thereafter, the model was fine-tuned using locally collected task-specific drone dataset, in the framework of transfer learning. The performance of each 5 cases was compared using Dice Score and Sensitivity, which are popular matrices for segmentation tasks, and the Binary cross-entropy outperformed the others in the test setting. The Dice Score for binary cross-entropy was 0.8334 while the sensitivity was 0.8203. One possible explanation of this is that Binary cross-entropy measures the dissimilarity between the predicted probabilities and the ground truth labels for each pixel independently, and it handles class imbalance well by assigning appropriate importance to each class during the optimization process, effectively preventing dominance by the majority class.

Keywords: Misquote vector surveillance, Drone images, Deep learning, Loss functions, SegNet
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