

Development of A Web-Based Deep Learning Application for Automatic Plankton Identification Using Transfer Learning and Data Augmentation

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ABSTRACT

Plankton identification in Indonesia still relies on manual light-microscope taxonomy, a process that is costly, time-consuming, and difficult to scale across the country's vast archipelago. Existing web-based platforms such as PlanktonFlow, RAPID, and EcoTaxa were built for temperate waters and do not account for the biogeographical complexity of Indonesia's tropical seas. This project developed IDmyPlankton, an automated web-based identification system built on EfficientNet-B0 transfer learning combined with a custom data augmentation pipeline simulating Indonesia's tropical optical conditions. Development followed a Hybrid Agile-Spiral methodology. The model was trained on 581 microscopy images spanning 56 species from nine sampling sites across Western and Eastern Indonesia, collected in collaboration with the National Research and Innovation Agency (BRIN). The system implements a three-tier user architecture with human-in-the-loop verification for low-confidence predictions. The final model achieved a top-1 accuracy of 89.77% and a macro F1-score of 85.98%, a 21.02-percentage-point improvement over the unaugmented baseline. User Acceptance Testing with 63 respondents produced a System Usability Scale score of 82.3 (Excellent) and a 98.4% positive recommendation rate. Limitations include a regional accuracy gap (92.31% Western versus 86.11% Eastern Indonesia) and a data-splitting issue affecting evaluation independence. The system contributes toward SDG 14 Target 14.a through low-cost marine technology transfer and SDG 4 Target 4.7 through a bilingual educational interface supporting plankton identification skills among Indonesia's coastal communities.

Keywords: *plankton identification, transfer learning, EfficientNet-B0, data augmentation, convolutional neural network, web-based system.*