Results of Deep Learning Approach for Frog Egg Quantification

Summer 2023-DeVision team-Graduates and Undergraduates*

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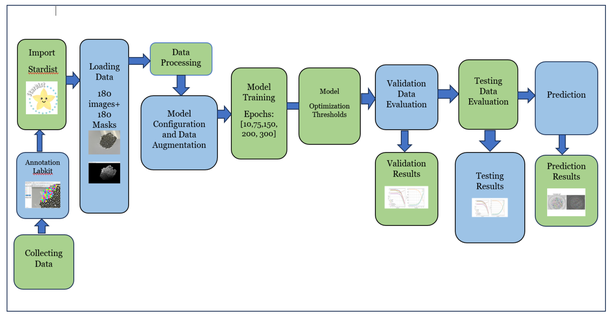
Flowchart-Training and Evaluation Process



The flowchart outlines a comprehensive workflow for training and evaluating a StarDist2D model on Frog egg images and masks. It begins with importing libraries, loading and preprocessing the dataset, and spliting the dataset into training, validation, and test sets. The model is configured with data augmentation, trained and evaluated, and performance metrics are saved and visualized. The entire process is conducted using the high-performance computing system "Chaos."

"Performance Analysis of U-Net CNN Architecture and StarDist on Dataset 180 with IOU > 0.5"

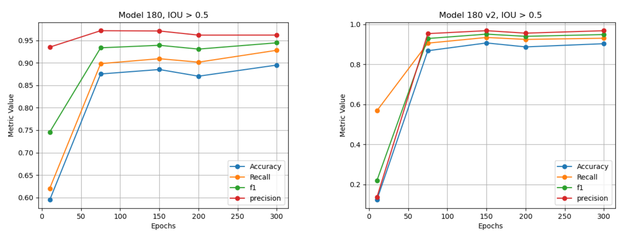


Figure 1. Illustration of Dataset 180 with v1 and v2 with reference to accuracy,recall,f1 score and precision

The graph depicts the variations in f1 score, accuracy, recall, and precision with respect to the Epoch during the training of U-Net CNN architecture and StarDist on Dataset 180, comprising 180 images and corresponding masks. The dataset was split into an 80-20 ratio for training and testing, and the models were evaluated using an Intersection over Union (IOU) threshold greater than 0.5. The experiment involved testing different Epochs with two model versions, namely Version 1 and Version 2. Both graphs exhibit a notable increase in accuracy after 50 epochs for both Version 1 and Version 2 models, indicating the significance of extended training iterations in enhancing model performance on object detection and recognition tasks.

"Optimal Epoch Selection for Efficient Training on Datasets of Various Sizes"

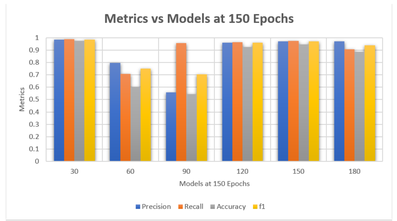


Figure 2. Illustration of the metrics-f1 score, Precision, Accuracy, and Recall on Epochs 150 and 300

The two bar graphs compare f1 score, accuracy, precision, and recall for datasets with varying image sizes (30 to 180 images). The StarDist model were trained for 150 and 300 epochs on each dataset. Surprisingly, 150 epochs training showed statistically similar performance to 300 epochs across all datasets. Furthermore, using 150 epochs training significantly reduced computational time, making it a more efficient option.

"Analysis of Training and Validation Metrics in a Distance Loss and Probability Loss Model"

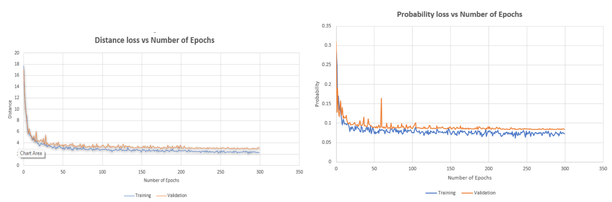


Figure 3. Illustration of Distance loss and Probability Loss with Number of Epochs

The Distance loss and Probability loss model's training and validation metrics exhibit the model's learning process and its ability to adjust its internal parameters to better fit the training data. The provided data represents training and validation metrics for a model with over 300 epochs. As we observe the metrics over time, we can see fluctuations in both training and validation scores, which is normal during the learning process.

Prediction and Results

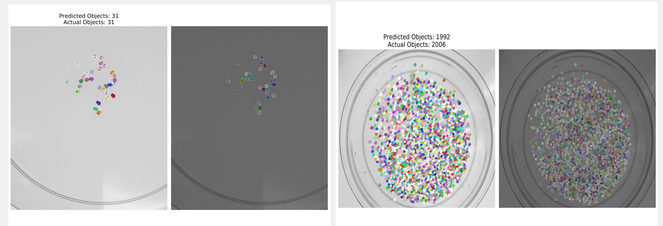


Figure 4. Prediction from the original number of eggs with an accuracy of 98 percent

After the model is been trained, it's tested on a completely new data set. The prediction was with an accuracy of 98 percent.

Future Work

In our future endeavors, we aspire to advance the field of egg counting in clustered environments. To achieve this, we plan to explore the performance of our model by introducing more noise and incorporating poor and unclear images. Additionally, we aim to enhance the model's capabilities by training it on a larger dataset comprising refined images with consistent dimensions. Going beyond mere egg counting, we will extend the model's functionality to classify and track the growth cycle of the eggs. To accomplish this, we intend to integrate a 3D Star Dist model based on the ResNet-CNN architecture, known for its effectiveness in handling complex visual data. To ensure widespread dissemination, we will prepare a comprehensive video presentation, guiding the general public through our step-by-step process and methodology.

Acknowledgements

- Department of Mathematics, Louisiana State University
- Aquatic Germplasm And Genetic Resources Center
- Chevron Patricia C. Bodin: https://www.lsufoundation.org/s/1585/17/interior.aspx?sid=1585gid=1pgid=3367
- We would like to acknowledge the Department of Mathematics for foreseeing the utility of "Chaos" and the subsequent purchase.
- We want to acknowledge and thank Nikkos Svoboda, Computer Analyst for introducing and making us familiar with the workings of high-performance computing system "Chaos".

References

[1] Uwe Schmidt, Martin Weigert, Coleman Broaddus, and Gene Myers.
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[2] Martin Weigert, Uwe Schmidt, Robert Haase, Ko Sugawara, and Gene Myers.
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