

## ABSTRACT

### COMPARISON BETWEEN BIDIRECTIONAL LONG SHORT-TERM MEMORY (BI-LSTM) AND BIDIRECTIONAL GATED RECURRENT UNIT (BI-GRU) FOR EARLY WARNING SYSTEM IN CATFISH (*CLARIAS GARIEPINUS*) AQUAPONIC POND

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This research compares the performance of Bidirectional Gated Recurrent Unit (Bi-GRU) and Bidirectional Long Short-Term Memory (Bi-LSTM) models using SMAPE and RMSE as evaluation metrics. The models were tested across three different training-to-test ratios: 90:10, 80:20, and 70:30.

In the training dataset, Bi-LSTM consistently achieved better performance in terms of the loss function, while the comparison between model's performance on the validation dataset, no clear winner emerged. Univariate analysis on testing dataset demonstrated superior results for dissolved oxygen, pH, and ammonia. The test dataset analysis revealed that Bi-GRU outperformed Bi-LSTM in univariate tests for temperature, pH, and ammonia, while Bi-LSTM performed better in multivariate tests. Interestingly, dissolved oxygen showed anomalous performance with a 70% training ratio yielding the best results, while ammonia consistently showed the poorest performance across all ratios. These findings suggest that parameter fluctuations and dataset irregularities, particularly in ammonia and dissolved oxygen, significantly impact model performance.

The results from the test dataset indicate that both Bi-GRU and Bi-LSTM models exhibit promising potential for real-world industrial applications, with several opportunities for improvement in future work. The models demonstrated high accuracy across various parameters, with the best accuracy for temperature, dissolved oxygen, pH, and ammonia reaching 99.3%, 93.9%, 99.3%, and 70.5%, respectively. These results highlight the models' effectiveness in predicting key environmental factors. However, the performance of ammonia remains relatively lower compared to other parameters, suggesting the need for further optimization, especially the IoT reading.

**Keywords:** Bi-GRU, Bi-LSTM, aquaponic pond, prediction model, catfish cultivation, neural network