Fish Image Classification using Custom CNN Model

1. Introduction

This document provides comprehensive documentation on the approach, implementation, and evaluation of a fish image classification model using a custom Convolutional Neural Network (CNN). The project aims to classify different species of fish based on image data. Due to the limited dataset size, classification reports for both the custom and transfer learning models showed suboptimal performance. However, the custom CNN model was selected as it performed consistently well on test data.

2. Approach

The project follows these key steps:

- GPU Detection: Ensure TensorFlow can access GPU for accelerated computation.
- Data Preprocessing: Use image augmentation techniques to enhance model generalization.
- Model Selection: Implement a custom CNN model.
- Training & Evaluation: Train the model, monitor its performance, and visualize results.
- Model Persistence: Save and load trained models for future use.

3. Results & Observations

- Training Performance: The custom CNN model showed stable training behavior with improved accuracy over epochs.
- Validation Performance: Due to the small dataset size, validation accuracy fluctuated, but generalization was acceptable.

- Test Data Performance: The model performed consistently on test images despite low classification report scores.

- Comparison with Transfer Learning: Transfer learning models (VGG16, ResNet50, MobileNet, etc.) did not yield significant improvements due to dataset limitations.

4. Conclusion

The custom CNN model was chosen as the final model for fish classification due to its consistent test performance. Future improvements could include:

- Increasing dataset size for better generalization.

- Fine-tuning transfer learning models with additional layers.

- Using techniques such as data augmentation and class weighting to improve classification performance.

5. Future Work

To enhance accuracy and robustness, future improvements may include:

- Collecting more training data.

- Experimenting with deeper CNN architectures.

- Exploring semi-supervised or self-supervised learning techniques.