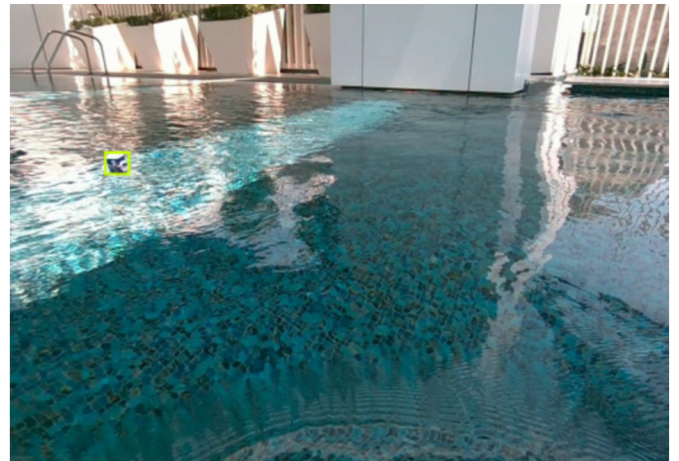
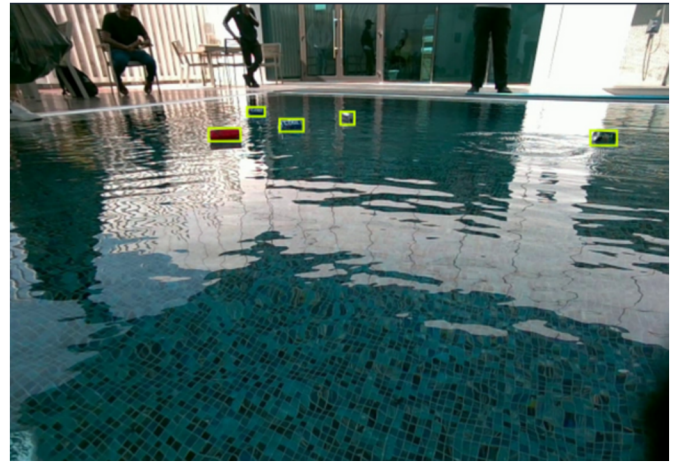
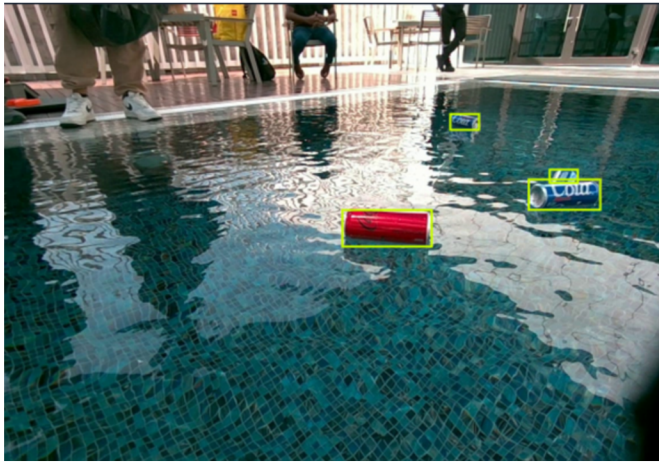
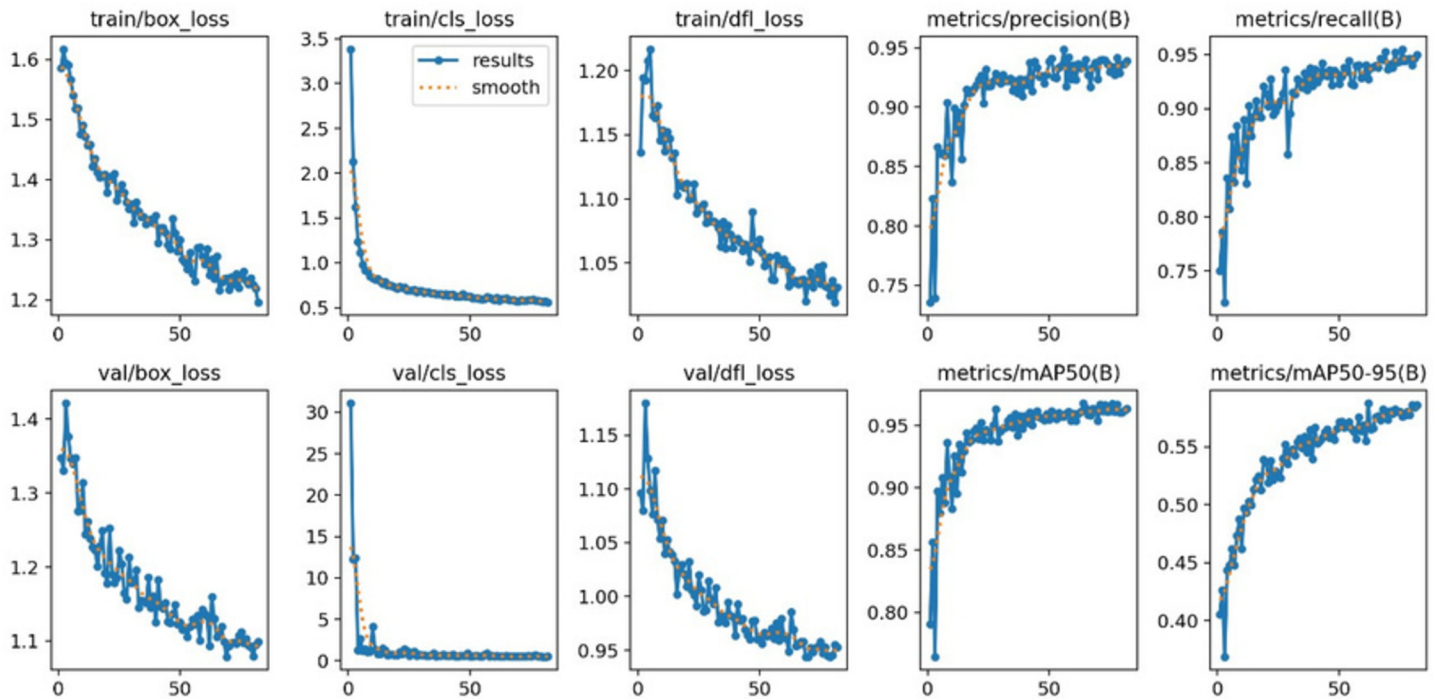


Annotated Data Set



- Annotated Dataset: The dataset consists of images or videos where various trash objects in water (e.g., plastic bottles, cans, etc.) have been manually labeled. The annotations typically include bounding boxes around trash objects with class labels (e.g., "plastic," "bottle," etc.).
- Object Detection: YOLO model learns to detect these trash objects based on the annotations. This involves the model learning to identify the location of each piece of trash in the environment (bounding boxes) and its corresponding class (type of trash).
- Tracking and Pathfinding for USV: Once trained, this object detection model can be used to identify trash in real-time during a USV's operation. The USV can then calculate the closest path to the detected trash, either to avoid it or to collect it.
- Goal of Dataset: The ultimate goal of the dataset is to assist in the autonomous navigation of the USV by providing the model with the information needed to detect and locate trash, enabling efficient path planning and navigation.

Training Performance Summary



Training Losses (Top Row - Left 3 Plots)

- 1.train/box_loss: Bounding box regression loss is steadily decreasing, which means the model is getting better at predicting object locations.
- 2.train/cls_loss: Classification loss drops sharply, showing that the model quickly learns to classify objects (e.g., different types of trash).
- 3.train/dfl_loss: The Distribution Focal Loss (related to localization) is also decreasing, indicating improved confidence in box positioning.

Interpretation: All training losses are decreasing, which is a clear sign of effective learning.

Training Metrics (Top Row - Right 2 Plots)

- 1.metrics/precision(B): Increases to above 0.94, meaning fewer false positives — the model is precise in its detections.
- 2.metrics/recall(B): Also rises above 0.94, indicating it's detecting almost all relevant objects.

Interpretation: Detection quality is improving as training progresses.

Validation Losses (Bottom Row - Left 3 Plots)

- 1.val/box_loss: Decreasing trend — the model generalizes well to unseen data.
- 2.val/cls_loss: Initially high but drops sharply, confirming that initial overfitting is corrected quickly.
- 3.val/df_l_loss: Decreasing steadily, again showing good generalization.

Interpretation: Validation losses mirror training loss behavior, meaning no overfitting is occurring.

Validation Metrics (Bottom Row - Right 2 Plots)

- 1.metrics/mAP50(B): Increases to around 0.96, confirming excellent detection on validation data.
- 2.metrics/mAP50-95(B): Rises gradually to ~0.6, showing the model is getting better at detecting with varying levels of IoU strictness.

Interpretation: Both detection quality and robustness are improving.

Overall Summary

These graphs together represent a well-trained model:

- Losses are consistently decreasing
- Metrics are increasing
- Training and validation trends are aligned, indicating good generalization and no overfitting