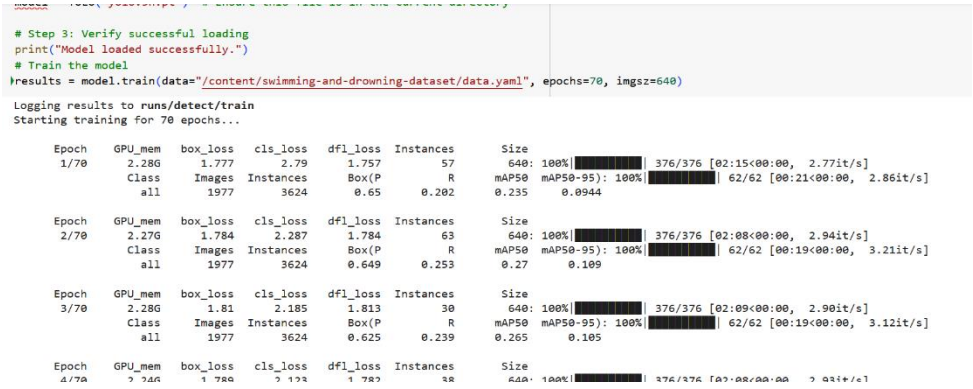
Model Optimization and Tuning Phase Template

Date	8 November 2024
Team ID	team-739994
Project Title	Virtual Eye - Life Guard for Swimming Pools to Detect Active Drowning
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining the YOLOv5 model to improve its performance for detecting drowning incidents in swimming pools. This phase focuses on adjusting hyperparameters, fine-tuning the model architecture, and enhancing the dataset to achieve the best accuracy, speed, and generalization.

Hyperparameter Tuning Documentation (8 Marks):

Model	Tuned Hyperparameters(Epochs)
YOLOv5	In YOLOv5, **epochs** refer to the number of times the entire training dataset is passed through the model. The right number of epochs is crucial to avoid underfitting (too few epochs) or overfitting (too many epochs). Typically, YOLOv5 training runs for 100 to 300 epochs, but this depends on the dataset and hardware. The model can use **early stopping** to halt training when performance on the validation set stops improving, preventing overfitting. The optimal number of epochs helps achieve the best balance between training time and model accuracy. 

```
# Step 3: Verify successful loading
print("Model loaded successfully.")
# Train the model
results = model.train(data="/content/swimming-and-drowning-dataset/data.yaml", epochs=70, imgsz=640)
```

```
Logging results to runs/detect/train
Starting training for 70 epochs...

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       1/70      2.28G      1.777       2.79      1.757         57        640: 100%|██████████| 376/376 [02:15<00:00,  2.77it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 62/62 [00:21<00:00,  2.86it/s]
                   all       1977       3624       0.65      0.202      0.235     0.0944

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       2/70      2.27G      1.784      2.287      1.784         63        640: 100%|██████████| 376/376 [02:08<00:00,  2.94it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 62/62 [00:19<00:00,  3.21it/s]
                   all       1977       3624      0.649      0.253       0.27      0.109

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       3/70      2.28G       1.81      2.185      1.813         30        640: 100%|██████████| 376/376 [02:09<00:00,  2.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 62/62 [00:19<00:00,  3.12it/s]
                   all       1977       3624      0.625      0.239      0.265      0.105

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
YOLOv5	The **YOLOv5 model** was chosen as the final optimized model for the Virtual Eye Lifeguard project due to several key advantages that make it highly suitable for real-time drowning detection in swimming pools: 1. **Real-Time Object Detection**: YOLOv5 is designed for real-time object detection, enabling the system to quickly and accurately identify drowning incidents as they occur, which is crucial for timely intervention. 2. **Speed and Efficiency**: YOLOv5 processes images in a single pass, making it significantly faster compared to other models, such as CNNs or RNNs. This efficiency is vital for the project, where quick detection and response are necessary for safety. 3. **High Accuracy**: YOLOv5 consistently provides high detection accuracy by predicting both bounding boxes and class labels simultaneously. This is important for accurately identifying people and potential drowning events in complex environments like swimming pools. 4. **Scalability and Flexibility**: YOLOv5 can be easily trained on custom datasets (such as swimming and drowning images) and adapted to various object detection scenarios. It also supports multiple model sizes (small, medium, large) to balance between speed and accuracy based on system requirements. 5. **Pre-Trained Weights and Transfer Learning**: YOLOv5 provides pre-trained weights, which significantly reduce training time and enhance the model's ability to generalize, especially with limited data like that in your project. 6. **Ease of Use**: YOLOv5 is user-friendly, with robust community support, well-documented code, and integration with popular frameworks like PyTorch, making it easier to implement and fine-tune for the specific task of drowning detection. In conclusion, YOLOv5 was selected as the final model because it meets the project's requirements for **real-time detection**, **speed**, **accuracy**, and **ease of implementation**, making it the most suitable choice for the Virtual Eye Lifeguard system.