HackWithHyderabad 2025 – Duality AI Space Station Challenge

Problem Statement: Safety Object Detection #2

Team Name: [Your Team Name]

Date: [Submission Date]

# 1. Introduction

The challenge focuses on object detection in a space station environment to ensure astronaut safety by detecting key safety equipment and potential hazards.  
We developed and trained an AI-powered object detection model that identifies multiple classes of safety-related objects with high accuracy.

# 2. Dataset Overview

- Dataset provided by Duality Falcon Platform.  
- Contains annotated images with bounding boxes for multiple object categories.  
- Objects include: Helmet, Gloves, Tools, Equipment, Hazards, etc.  
- Train/Validation/Test split: 70/20/10.

# 3. Methodology

3.1 Model Selection  
- Chosen baseline: YOLOv8 (Ultralytics) due to its efficiency and accuracy in real-time detection.  
- Alternative experiments: Faster R-CNN, YOLOv5.  
  
3.2 Training Setup  
- Framework: PyTorch  
- Hardware: [Specify – GPU/Colab/Local Machine]  
- Hyperparameters:  
 - Epochs: 50  
 - Batch size: 16  
 - Learning rate: 0.001  
 - Optimizer: Adam  
  
3.3 Data Augmentation  
- Random flips, rotations, brightness adjustments.  
- Augmentations improved robustness under varying space station lighting.

# 4. Results & Evaluation

4.1 Metrics  
- Precision: XX%  
- Recall: XX%  
- F1-Score: XX%  
- mAP@0.5: XX%  
- IoU Threshold: 0.5  
  
4.2 Visual Results  
- Detection outputs showing bounding boxes on test images.  
- Confusion matrix.  
- Precision-Recall curve.

# 5. Observations

- Strong performance on detecting Helmets and Gloves.  
- Lower recall for floating tools due to shape/size variance.  
- Augmentation improved robustness.

# 6. Bonus Use Case Proposal (Optional)

Use Case: Astronaut Safety Monitoring System  
- Problem: Astronauts risk hazards when equipment is missing or improperly used.  
- Solution: Deploy real-time AI object detection in space station surveillance feeds.  
- Impact: Automated alerts, reduced risk of accidents, improved compliance with safety protocols.

# 7. Conclusion

Our model achieves strong detection accuracy, with potential deployment for real-world space missions.  
Future improvements include real-time integration with space station cameras and edge deployment on low-power devices.