**1. Introduction**

This test plan covers the unit and integration testing strategy for the Deep Learning Object Detection project.  
The goal is to verify that:

* The code is functional.
* The environment can be set up from scratch.
* The system behaves correctly even without datasets available.
* CI/CD automation detects major failures early.

**2. Unit Testing**

| **Test Case** | **Description** | **Expected Result** |
| --- | --- | --- |
| Import Test | Confirm train\_combined.py and predict\_combined.py import required libraries | No import errors |
| Model Loading | Load trained YOLO model from .pt file | Model loads successfully |
| Inference Startup | Initialize model inference on an image or video frame | Model returns predictions without crashing |
| Dependency Validation | Validate that requirements.txt installs necessary packages | No missing packages |

**3. Integration Testing**

| **Test Case** | **Description** | **Expected Result** |
| --- | --- | --- |
| Training Dry-Run | Run train\_combined.py without full dataset | Script starts, sets up model, and handles missing dataset gracefully |
| Inference Dry-Run | Run predict\_combined.py on a small sample | Script detects objects and draws bounding boxes |
| CI/CD GitHub Actions Dry-Run | Auto-run on push to GitHub | Workflow succeeds or produces warning about missing data (but does not crash) |

**4. Tools Used**

* Python 3.11
* PyTorch (CPU version)
* Ultralytics YOLOv8
* GitHub Actions (for automated dry run testing)

**5. Testing Procedures**

* Manual testing by running scripts in a clean virtual environment.
* Automated testing via GitHub Actions workflow:
  + Install dependencies.
  + Attempt dry run of training script.
  + Allow missing dataset errors gracefully.
* Testing across multiple platforms (Windows development, Ubuntu runner on GitHub).

**6. Expected Results**

| **Success Criteria** | **Definition** |
| --- | --- |
| Dry run passes | No fatal errors during setup or script startup |
| Model loads | .pt file loads without exceptions |
| Environment installs | requirements.txt fully satisfies dependencies |
| GitHub workflow green | CI pipeline completes successfully or shows acceptable warnings |