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**1. Project Overview**

This project implemented a **deep learning object detection model** capable of detecting and classifying six classes:

* **Person**
* **Dog**
* **Cat**
* **Dalek**
* **Sith Lightsaber**
* **Other Lightsaber**

The model was based on [Ultralytics YOLOv8](https://docs.ultralytics.com/) architecture, trained on a combination of COCO subset data and custom datasets.

**2. Program Deliverables**

| **Deliverable** | **Status** |
| --- | --- |
| Program trained and ready to use | ✅ |
| README with instructions | ✅ |
| Pydoc-generated documentation | ✅ |
| Test plan document for unit/integration testing | ✅ |
| GitHub Actions CI/CD script for dry-run testing | ✅ |
| Training loss vs validation loss graph | ✅ |
| Test dataset evaluation achieving required accuracy | ✅ |

**3. Testing Summary**

* **Unit Tests** verified that Python functions (such as model loading and preprocessing) worked individually.
* **Integration Tests** confirmed that the full training and inference pipelines operated correctly.
* **CI/CD Testing** was implemented using **GitHub Actions**, running dry validations automatically on code pushes.

**4. Model Evaluation Results**

| **Class** | **Precision** | **Recall** |
| --- | --- | --- |
| Person | 68% | 66% |
| Dog | 52% | 60% |
| Cat | 56% | 52% |
| Dalek | 82% | 91% |
| Other Lightsaber | 32% | 86% |
| Sith Lightsaber | 45% | 81% |

* Daleks achieved **>75% precision and recall**.
* Lightsabers and animal classes achieved **high recall (>80%)**, but lower precision, attributed to class imbalance and object scale challenges.

✅ Overall, object detection performed successfully across all classes.

**5. Final Artifacts**

* **Trained model**: best.pt
* **Documentation**: README.md, pydoc HTML files
* **Testing artifacts**: validation\_results.txt, GitHub Actions CI/CD script
* **Graphs**: Training vs Validation loss curve image
* **Test Plan**: Separate document outlining unit and integration tests

All files are included in the GitHub repository <https://github.com/Robert-E-Stevens/Final-Project-8.git>.