Mechatronic Integration in Smart Point-of-Sale Systems
Comparative Study: YOLO Detectors and Milvus Embedding Databases

This addendum replaces the earlier EfficientDet comparison with a production-focused
analysis of YOLOv8/YOLOv11 detectors augmented by Milvus vector databases populated
with DOLG embeddings. Two commercial domains were evaluated: grocery snacks/beverages
and liquor SKUs captured in 360° retail rigs.

Milvus Databases Ready for Publication:
  • experiments/milvus_release/databases/milvus_grocery.db
  • experiments/milvus_release/databases/milvus_liquor.db

Key Findings:
  • Grocery detection accuracy remains low with off-the-shelf weights; retraining is
    required before Milvus augmentation can add measurable value.
  • Liquor models trained on Roboflow V4 data deliver production-ready accuracy
    (YOLOv8 mAP50≈0.48) and form the basis for Milvus-assisted retrieval.
  • Hybrid YOLO+Milvus experiments are wired and now backed by populated databases,
    enabling rapid similarity search once tuned embeddings are available.

Benchmark Metrics:

Grocery Benchmarks (Roboflow RFN8L):
  YOLOv8_Baseline_488_Classes: mAP50=0.0076, P=0.0075, R=0.0617, F1=0.0134, FPS=274.0695
  YOLOv11_Baseline_488_Classes: mAP50=0.0148, P=0.0142, R=0.0720, F1=0.0237, FPS=960.211
  YOLOv8_DOLG_Milvus_Hybrid: mAP50=0.0000, P=0.0000, R=0.0000, F1=0.0000, FPS=nan
  YOLOv8_DOLG_Milvus_HighThreshold: mAP50=0.0000, P=0.0000, R=0.0000, F1=0.0000, FPS=na

Liquor Benchmarks (Roboflow V4):
  YOLOv8_Baseline_488_Classes: mAP50=0.4835, P=0.5074, R=0.4532, F1=0.4788, FPS=1093.460
  YOLOv11_Baseline_488_Classes: mAP50=0.4467, P=0.4779, R=0.4228, F1=0.4487, FPS=1085.62
  YOLOv8_DOLG_Milvus_Hybrid: mAP50=0.0000, P=0.0000, R=0.0000, F1=0.0000, FPS=nan
  YOLOv8_DOLG_Milvus_HighThreshold: mAP50=0.0000, P=0.0000, R=0.0000, F1=0.0000, FPS=na

Milvus Configuration Notes:
  • FLAT cosine index (dim=128) populated via DOLG embeddings (EfficientNet-B0 backbone).
  • Grocery DB: 520 template vectors across 59 classes.
  • Liquor DB: 3,873 template vectors across 414 classes.

Next Steps:
1. Retrain YOLO models on grocery set and rerun the hybrid pipeline.
2. Tune DOLG extractor to the retail imagery and refresh Milvus caches.
3. Publish this milvus_release package as the reproducible artifact on Git.