1. PROJECT REVIEW & DEFINITION

The "Intent" Gap

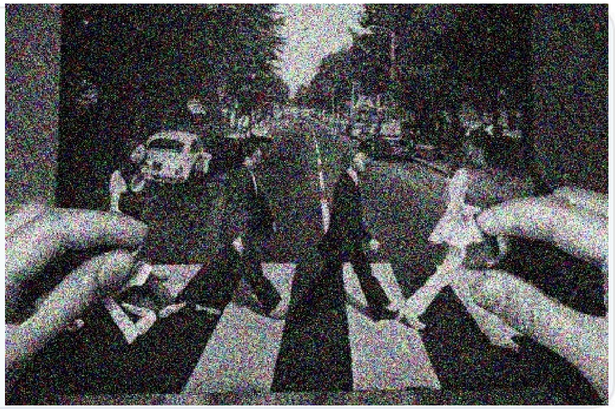
Bridging the gap between POS sales data and actual customer browsing behavior on the shop floor.

The CCTV Challenge

Identifying vinyl albums from low-quality, grayscale, and noisy CCTV "crops".

Objective

Developing an Image Retrieval system to match degraded query images to a clean reference catalog.



MODELS, DATA & METRICS

- **Core Architecture:** ResNet50 Siamese Network.
- **Training Strategy:** Optimized using Triplet Margin Loss for robust embeddings.
- **Synthetic Dataset:** 5,000 images generated using GLIGEN AI-inpainting.
- **Evaluation Metrics:** Measured by Precision1 (P1) and Precision5 (P5) accuracy.

2. ACHIEVEMENTS & NOVELTY

Key Achievements

- **High-Accuracy Retrieval:** Achieved 89% Top-5 and 77% Top-1 accuracy on entirely unseen album covers.
- **Robust Domain Adaptation:** Successfully mapped heavily degraded, grayscale CCTV crops to sharp, high-resolution catalog embeddings.
- **Performance vs. Complexity:** Demonstrated that ResNet50 outperforms shallow architectures in extracting features from noisy inputs.

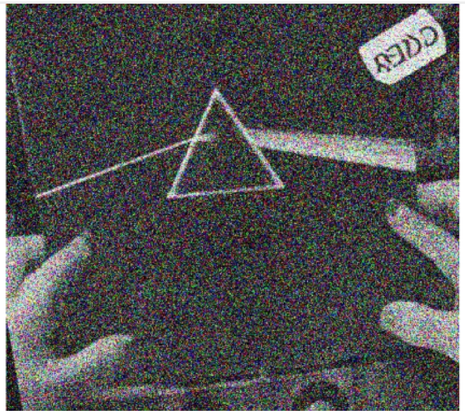
Core Novelty

- **AI-Powered Occlusion Synthesis:** Innovative use of GLIGEN to generate realistic human-hand occlusions and price stickers, surpassing traditional methods.
- **Overcoming Data Scarcity:** Created a specialized synthetic-to-real pipeline to train models where real samples are missing.

3. METHODOLOGY & PIPELINE

1. Clean Catalog Image

2. Generated CCTV Query



The Pipeline Workflow

Step 1: Data Gen. 5,000 samples with GLIGEN hands + CCTV filters.

Step 2: ResNet50 backbone creating 128-dim embeddings.

Step 3: Triplet Margin Loss with hard negative mining.

Step 4: Generalization test on 100 images not seen in training.

Technique: We used **spatially-precise** inpainting to ensure the added hands realistically overlap the record geometry.

4. EXPERIMENTAL RESULTS

Model / Setup	P1 Accuracy	P5 Accuracy
Random Guess	2.0%	10.0%
ResNet18 (Baseline)	67.0%	78.0%
ResNet50 (Final)	**77.0%**	**89.0%**

Validated on 100 completely unseen album covers (Zero-Shot)

Key Insights:

- **Generalization:** 89% Top-5 accuracy on 100 unseen images.
- **Superior Extraction:** ResNet50 outperformed baseline by 11%.
- **Reliability:** Robust even under extreme noise/occlusions.

5. FINAL CONCLUSION

Goals Achieved

Successfully built a system that identifies vinyl covers from messy footage with 89% top-5 accuracy, solving the intent gap.

Key Lessons

AI-driven data generation (GLIGEN) is superior to standard augmentations for training on real-world occlusions.

Future Work

Scaling to 10,000+ items and testing on real-time video streams for live store analytics.


NIRVANA
NEVERMIND