CS 5330 - Pattern Recognition and Computer Vision

Project 2: Content-based Image Retrieval Report

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Date: January 2026

Course: CS 5330 Pattern Recognition and Computer Vision

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1. Project Description (≤200 words)

This project implements a content-based image retrieval (CBIR) system that matches a query image to a database by comparing visual features. The system supports baseline patch matching, color histograms, multi-region histograms, texture histograms (Sobel magnitude), deep network embeddings, and a custom feature configuration for a chosen category. Each method produces a feature vector for the target and database images, computes a distance metric, and returns the top-N closest matches.

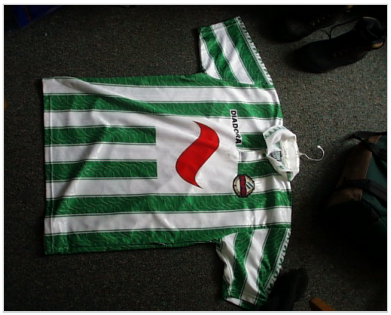
2. Required Results

Task 1 — Baseline Matching

- Query: pic.1016.jpg
- Top matches: pic.1016.jpg, pic.0986.jpg, pic.0641.jpg, pic.0547.jpg

pic.1016.jpg (query)

pic.0986.jpg



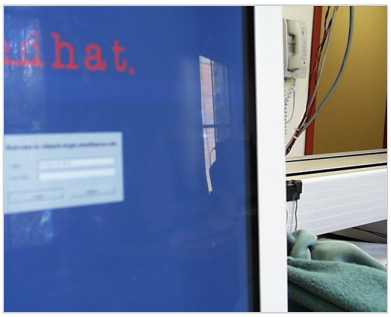
pic.0641.jpg

pic.0547.jpg

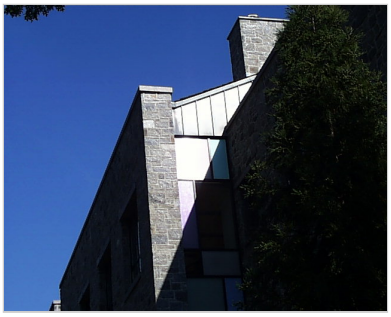
Task 2 — Histogram Matching

- Query: pic.0164.jpg
- Top matches: pic.0164.jpg, pic.0080.jpg, pic.1032.jpg, pic.0461.jpg

pic.0164.jpg (query)



pic.0080.jpg



pic.1032.jpg

pic.0461.jpg

Task 3 — Multi-histogram Matching

- Query: pic.0274.jpg
- Top matches: pic.0274.jpg, pic.0273.jpg, pic.1031.jpg, pic.0409.jpg

pic.0274.jpg (query)

pic.0273.jpg

pic.1031.jpg

pic.0409.jpg

Task 4 — Texture + Color

- Query: pic.0535.jpg
- Top matches: pic.0535.jpg, pic.0004.jpg, pic.0001.jpg, pic.0356.jpg

- Comparison vs Task 2/3: Texture+color emphasizes structural similarity more than color-only histograms.

pic.0535.jpg (query)

pic.0004.jpg

pic.0001.jpg

pic.0356.jpg

Task 5 — Deep Network Embeddings

- Query: pic.0893.jpg

- Top matches: pic.0893.jpg, pic.0897.jpg, pic.0136.jpg, pic.0146.jpg
- Query: pic.0164.jpg
- Top matches: pic.0164.jpg, pic.1032.jpg, pic.0213.jpg, pic.0690.jpg
- Comparison vs classic features: DNN results preserve semantic content better than color-only histograms.

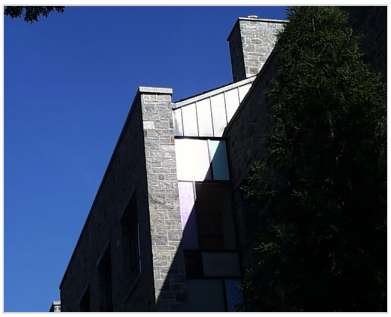
pic.0893.jpg (query)

pic.0897.jpg

pic.0136.jpg

pic.0146.jpg

pic.0164.jpg (query)



pic.1032.jpg

pic.0213.jpg

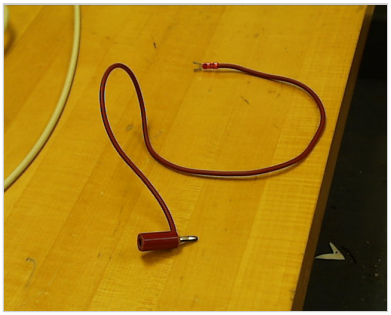
pic.0690.jpg

Task 6 — Classic vs DNN Comparison

- Queries: pic.1072.jpg, pic.0948.jpg, pic.0734.jpg
- Summary: Histogram RG favors color similarity, while DNN embeddings return more semantically consistent scenes.

Task 7 — Custom Design (Sunset-Oriented Feature)

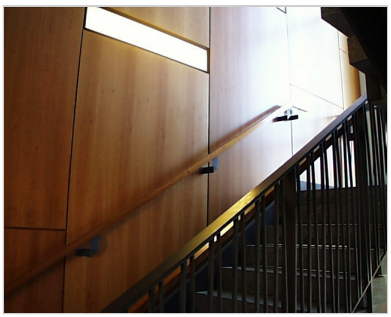
- Queries: pic.0048.jpg, pic.0552.jpg
- Top 5 matches (pic.0048.jpg): pic.0048.jpg, pic.0552.jpg, pic.0533.jpg, pic.1003.jpg, pic.1059.jpg
- Least similar (pic.0048.jpg): pic.0511.jpg, pic.0558.jpg, pic.0228.jpg, pic.0890.jpg, pic.0689.jpg
- Top 5 matches (pic.0552.jpg): pic.0552.jpg, pic.0048.jpg, pic.0324.jpg, pic.0197.jpg, pic.0958.jpg
- Least similar (pic.0552.jpg): pic.0511.jpg, pic.0558.jpg, pic.0228.jpg, pic.0890.jpg, pic.0046.jpg



pic.0048.jpg (query)

pic.0552.jpg (query)

pic.0533.jpg



pic.1003.jpg

pic.1059.jpg

3. Extensions

None.

4. Reflection

Building multiple feature extractors highlighted how each representation captures different aspects of similarity. Color histograms were fast and intuitive but biased toward palettes, while adding texture emphasized structural patterns. The DNN embeddings produced more semantically consistent matches when color alone was ambiguous. The custom sunset feature benefited from spatial weighting toward the sky region, which aligned well with the dataset.

5. Acknowledgments

Sourav Das, Joseph Defendre. Course materials and OpenCV documentation.