

Compressed Image-Based Retrieval: Scalable Recognition of CD Covers

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Motivation

Compressed Image-Based Retrieval 2

Outline

- Feature-based CD recognition
 - Scalable vocabulary tree (SVT) of CD features
 - Enhanced preprocessing and querying
 - Experimental results
- Eigenimage-based CD recognition
 - Principal component analysis of CD images
 - Video of real-time demo

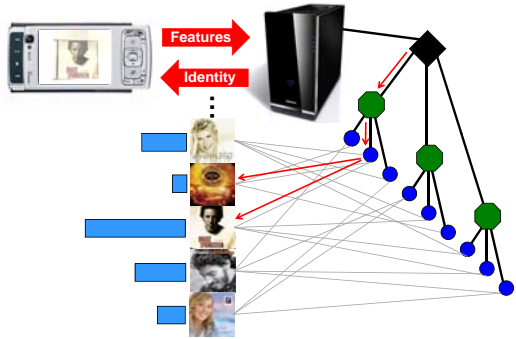
Building Scalable Vocabulary Tree (SVT)

*Nister and Stewenius
CVPR 2006*

Building SVT

Building SVT

Querying through SVT



Preprocessing to Boost Feature Extraction

Low-contrast query image



165 features extracted

Preprocessing to Boost Feature Extraction

Enhanced-contrast query image



394 features extracted

Preprocessing to Boost Feature Extraction

Low-contrast query image



158 features extracted

Preprocessing to Boost Feature Extraction

Enhanced-contrast query image



343 features extracted

Preprocessing to Boost Feature Extraction

Low-contrast query image



93 features extracted

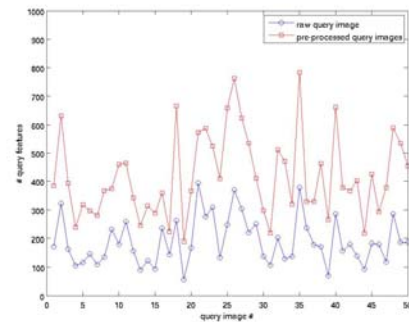
Preprocessing to Boost Feature Extraction

Enhanced-contrast query image

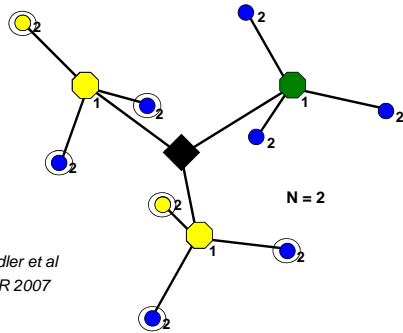


288 features extracted

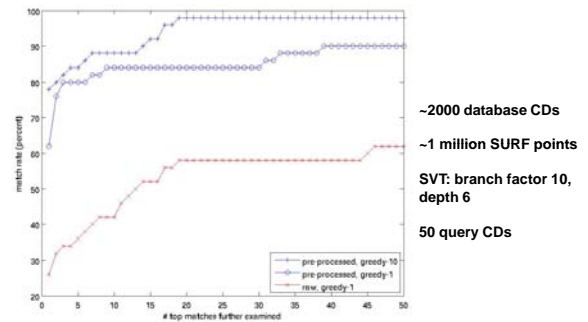
Preprocessing to Boost Feature Extraction



Greedy-N Querying through SVT



Match Rates



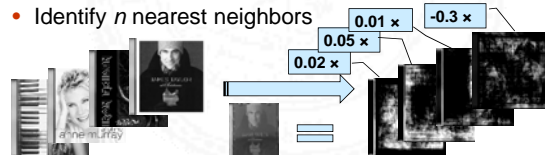
Eigenimage-Based CD Recognition

- Main computational cost is pre-processing
 - Decimate image to a thumbnail (~200 x ~200)
 - Sobel edge detection to segment CD
 - Floodfill CD region
 - Isolate largest region (eliminates noise, other objects)
 - Transform convex hull of largest region to 128 x 128 square
 - Project into eigenspace



Greeting Your Neighbors in Eigenspace

- Eigenspace created from ideal image stack
- Eigenvectors of covariance matrix are orthonormal
 - Maximally separated axes between images in eigenspace
 - Eigenspace is the domain with least likelihood of error in nearest neighbor search
- Juxtapose query eigencefficients with database
- Identify n nearest neighbors

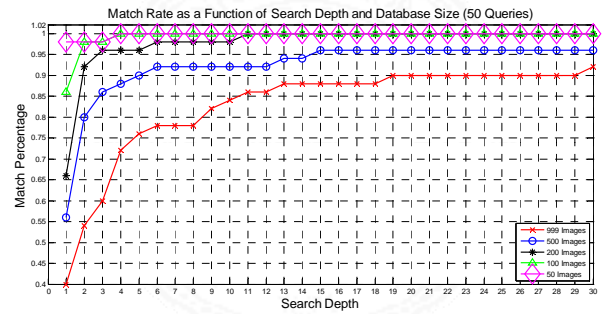


Eigenimage Optimization Schemes

- Q: Failed preprocessing?
- A: Contrast enhancement
- Q: Several similar queries fail?
- A: Query image prediction and mimicry
- Q: Difficult angles or queries?
- A: Redundancy in database



Eigenimage Database Query Match Rate



Goals for the (Near) Future

- Robust identification despite challenging ambience
 - Successively more pathological stress testing
 - Varying illumination
 - Tilting angles, camera placement
- Real-time recognition in hand, or on shelf
- Color information?



Conclusion

- Several ways to identify CD covers
 - Feature-Based: Scalable Vocabulary Tree (SVT)
 - Statistic-Based: Principal Component Analysis (PCA)
- Large Database Size
 - Effective to use SVT
 - Eigenimages for small, rapid, limited database
- Communication to image database on server
 - SVT: Send key feature set, search at server
 - PCA: Send eigen-coefficients, compare at server
- Real-Time Demo