Content Based Image Retrieval with LIRe

Abstract. LIRe (Lucene Image Retrieval) is an open source library for content based image retrieval. Besides providing multiple common and state of the art retrieval mechanisms it allows for easy use on multiple platforms. LIRe is actively used for research, teaching and commercial applications. Due to ist modular nature it can be used on process level (e.g. index images and search) as well as on image feature level. Developers and researchers can easily extend and modify LIRe to adapt it to their needs.

ALPEN-ADRIA UNIVERSITÄT
KLAGENFURT | WIEN GRAZ

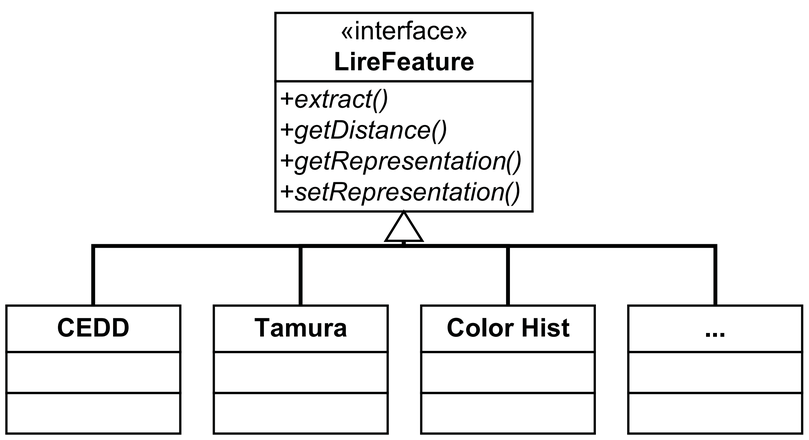
mail&web

Dr. Mathias Lux
Klagenfurt University / ITEC
Universitätsstrasse 65-67
Klagenfurt, Austria
mlux@itec.uni-klu.ac.at
tinyurl.com/mlux-itec

Global & Local Image Features
- Color Histograms with different color spaces & metrics
- MPEG-7 scalable color, color layout and edge histogram
- Tamura features coarseness, contrast and directionality
- Joint histograms CEDD, FCTH and JCD
- Auto color correlation as defined by Huang et al
- JPEG coefficients histogram
- SIFT (using the ImageJ implementation)
- SURF (using jopensurf)
- MSER based on the algorithm of Nister & Stewenius
- ... and more to come

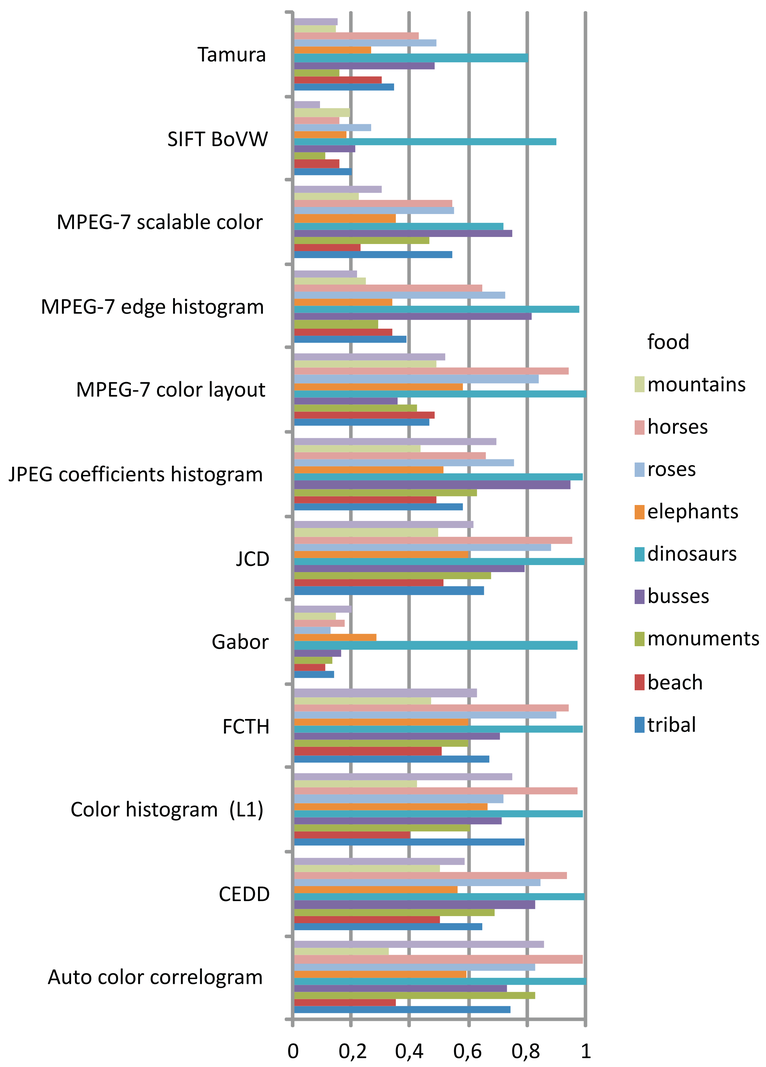
Indexing & Search
- Fast linear search based on Lucene index technology
- Fast BoVW search based on Lucene text indexing
- Parallel *k*-means & visual word indexing for BoVW
- Fastmap for spatial indexing
- Metric spaces approach for fast search in global features

Performance
Linear search heavily depends on the size of the index. Restricting indexing to a single feature allows for reasonable speed with big datasets. Tests with 121,379 images have shown that indexing with CEDD, which produces a very small feature vector, leads to a index with 29 MB. Searching this index takes roughly *330 ms* on a AMD quad core with 4GB RAM. Using BoVW tests have shown a search time of *33 ms* for the same dataset.
Lucene index management also allows for loading the whole index into RAM to minimize disk I/O and to distribute it on a network to deal with large indexes.



Retrieval Performance
Performance on the Wang Simplicity data: mean average precicion (map), precision at ten (p@10) and error rate (er) in the table and map per category per feature in the graph.

name	map	p@10	error rate
Auto color correlogram	0,475	0,725	0,171
CEDD	0,506	0,710	0,178
Color histogram (L1)	0,484	0,704	0,205
FCTH	0,498	0,703	0,209
Gabor	0,233	0,248	0,707
JCD	0,510	0,719	0,177
JPEG coefficients histogram	0,446	0,669	0,215
MPEG-7 color layout	0,439	0,610	0,309
MPEG-7 edge histogram	0,333	0,500	0,401
MPEG-7 scalable color	0,305	0,469	0,461
SIFT BoVW	0,183	0,243	0,687
Tamura	0,253	0,359	0,601



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