FaceTracer: A Search Engine for Large Collections of Images with Faces

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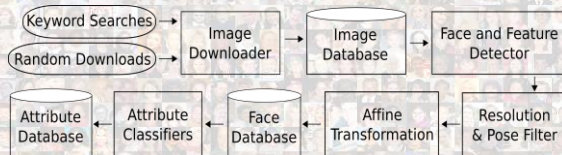http://www.cs.columbia.edu/CAVE/projects/facesearch/

Overview

FaceTracer is the first **face search engine**

- Built using over **3 million** face images
- "**Real-world**" images collected from the internet
- Simple **attribute-based** text queries
- **Automatic selection** of best features for each attribute

Database Creation

Our Database: 3,131,075 Faces

17,454 Labeled Faces

Attribute	Labeled	Attribute	Labeled
Gender (2)	1,954	Mustache (2)	1,947
Age (5)	3,301	Smiling (2)	1,571
Race (3)	1,309	Blurry (2)	1,763
Hair Color (2)	1,033	Lighting (2)	633
Eye Wear (3)	2,360	Environment (2)	1,583

Training

Face Regions
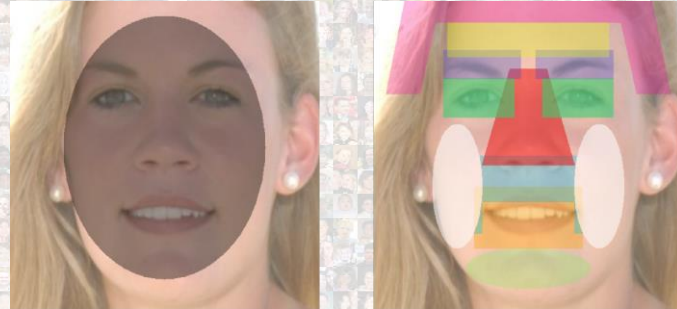
■ Whole Face (W)	■ Hair (H)	■ Cheeks (K)	■ Chin (C)
■ Eyebrows (B)	■ Eyes (E)	■ Upper Lip (U)	
■ Forehead (F)	■ Nose (N)	■ Mouth (M)	

Feature Types

Pixel Value Type	Normalizations	Aggregation
(r)gb	(n)one	(n)one
(h)sv	(m)ean-Norm	(h)istogram
(i)ntensity	(e)nergy-norm	(s)tatistics
Edge (m)agnitude		
Edge (o)rientation		

Training Process

1. Train local SVMs for each region/feature type combination
2. Use Adaboost to select best features
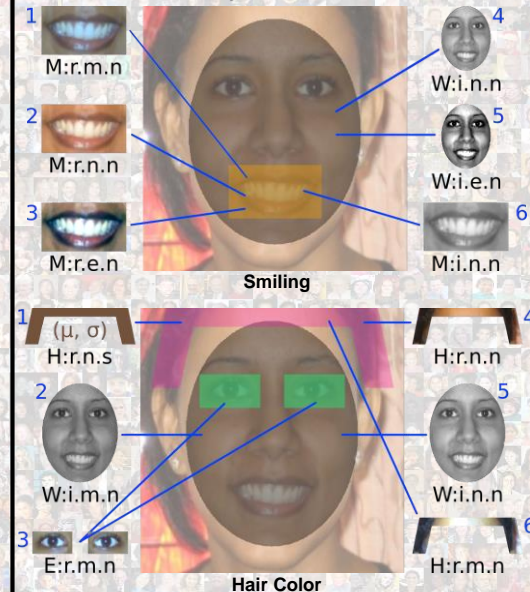3. Train global SVM on union of selected features

Local SVMs	Classifications Ex. 1 Ex. 2 Ex. 3 Ex. 4	Adaboost Weights	Global SVM
N:r.n.s	1 1 1 1	0.1	
W:r.n.p	1 0 1 1	0.8	W:r.n.p
E:l.m.p	0 1 0 0	0.5	E:l.m.p
M:h.e.p	0 0 1 0	0.1	
W:o.n.h	1 0 0 0	0.4	W:o.n.h
C:r.m.h	0 0 0 0	0	
M:m.n.h	1 1 1 1	0	

Results

Classification Performance

Attribute	Error Rate	Attribute	Error Rate
Gender	8.62%	Mustache	4.61%
Age	16.65%	Smiling	4.60%
Race	6.49%	Blurry	3.41%
Hair Color	5.54%	Lighting	1.61%
Eye Wear	5.14%	Environment	12.15%

Automatically Selected Features

1 M:r.m.n
2 M:r.n.n
3 M:r.e.n
4 W:i.n.n
5 W:i.e.n
6 M:i.n.n

Smiling

1 (μ, σ) H:r.n.s
2 W:i.m.n
3 E:r.m.n
4 H:r.n.n
5 W:i.n.n
6 H:r.m.n

Hair Color

Comparison to State-of-the-Art

Method	Gender Error Rate	Smiling Error Rate
Ours	**8.62%**	**4.60%**
Baluja & Rowley, IJCV 2007	13.13%	7.41%
Shakhnarovich et al., ICAFGR 2002	12.88%	6.40%
Moghaddam & Yang, TPAMI 2002	9.52%	13.54%