

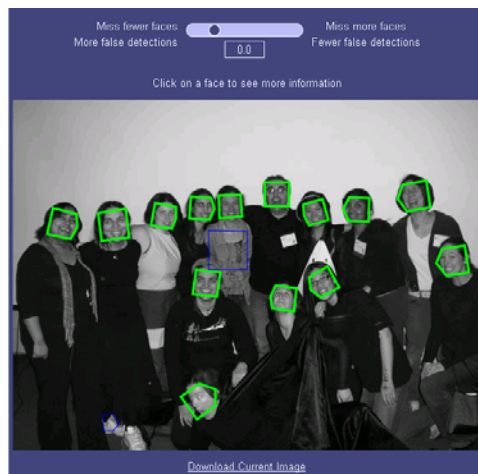
High-Level Vision

Face Recognition I



CS332 Visual Processing
Department of Computer Science
Wellesley College

Pittsburgh Pattern Recognition Face Detection Results

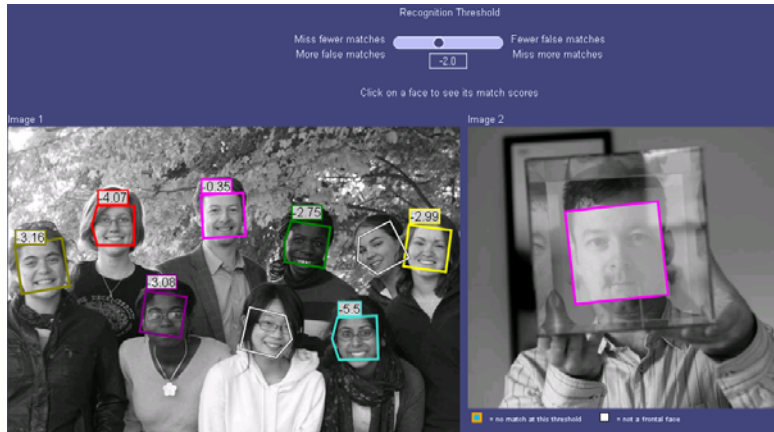


Pitt Patt recently
purchased by Google



*CS cast of characters,
2007 Cirque du CS*

Pittsburgh Pattern Recognition Face Recognition Results



Bevil Conway & students, 2008

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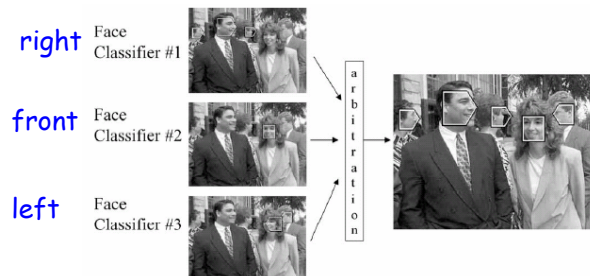
Schneiderman & Kanade (2004) Face Detection

Statistical approach: classifiers assess likelihood of face vs. non-face in each image region

View-based: 3 classifiers specialized to detect front, left profile and right profile views

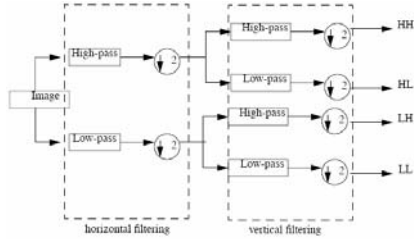
Multi-resolution: classifiers applied at multiple spatial scales

Learns statistical distribution of face vs. non-face image patterns from large database of examples



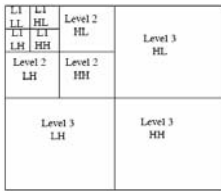
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Image Representation Using Wavelets

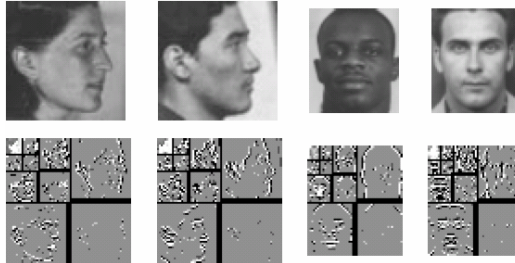


Images first processed with "Wavelet" filters - selective for spatial frequency (scale) and orientation (horizontal/vertical)

- Multiple scales via down-sampling
- Results quantized to 5 levels



Wavelet representation

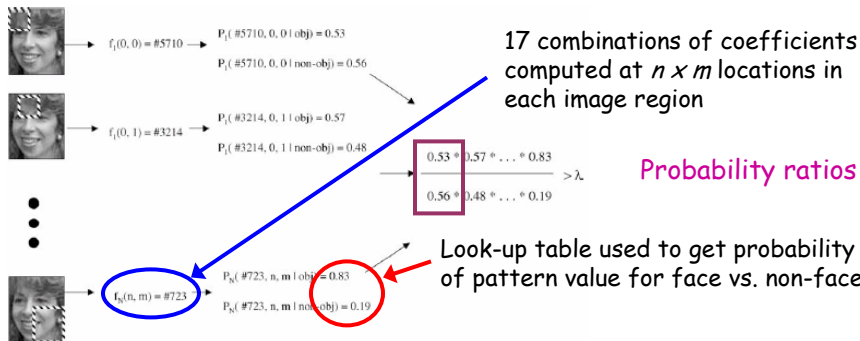


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Statistical Approach Uses Probabilities

$$\frac{P(\text{image} | \text{object})}{P(\text{image} | \text{non-object})} \approx \prod_k \prod_{x, y \in \text{region}} \frac{P_k(\text{pattern}_k(x, y), i(x), j(y) | \text{object})}{P_k(\text{pattern}_k(x, y), i(x), j(y) | \text{non-object})} > \lambda$$

$\text{pattern}_k(x, y)$: combination of Wavelet coefficients computed for small image window centered at location (x, y)

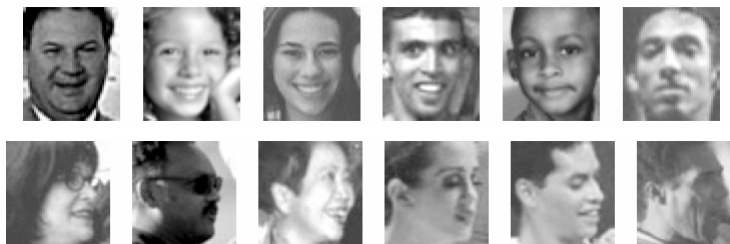


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Learning Probability Distributions

Compute statistical distributions (histograms) of values for each $pattern_k$ over 1000's of image regions containing face vs. non-face

- Hand-labeled landmark points used to adjust to common position, size, orientation
- Learning: misclassified image regions given more weight in refinement of probability distributions



Sample training images

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Schneiderman & Kanade (2004) Results

Numerical results for Kodak test set (17 images containing 46 faces, some with poor lighting, contrast or focus)

| γ | Detection (all faces) | Detection (profiles only) | False Detections |
|----------|-----------------------|---------------------------|------------------|
| 0.5 | 80.4% | 86.1% | 105 |
| 1.0 | 70.0% | 69.4% | 7 |
| 1.5 | 63.0% | 61.1% | 1 |

threshold

| γ | Detections (all faces) | Detection (profiles) | False Detections |
|----------|------------------------|----------------------|------------------|
| 0.0 | 92.7% | 92.8% | 700 |
| 1.5 | 85.5% | 86.4% | 91 |
| 2.5 | 75.2% | 78.6% | 12 |

Numerical results from additional test set of 208 images containing 441 faces with varying poses

Matching of faces for recognition based on same $pattern_k$ (Wavelet) values used in face detection



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