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Face Parts Importance in Face and Expression Recognition

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The 22nd International Conference on Systems, Signals and Image Processing, IWSSIP 2015, London, United Kingdom

Overview

- Motivation
- State-of-the-art
- Databases
- Used methods
- Proposed methodology
- Experimental results
- Future work

Motivation

- identification of the important face parts
- data and time complexity reduction
- face and facial expression recognition
- approach applicable to any feature space

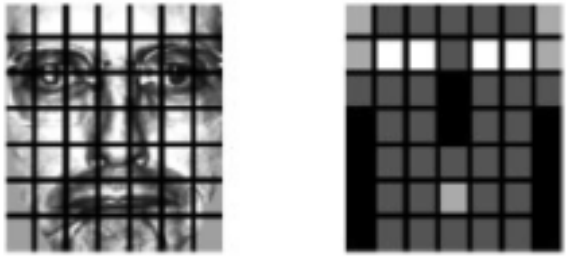
Motivation

- obscured identity of the subject

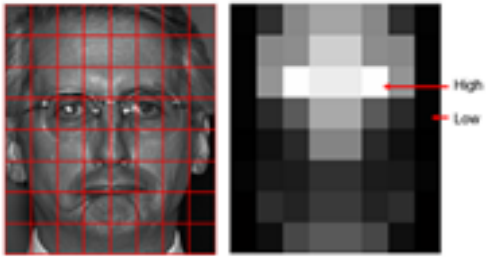
- medical images

- surveillance video or police records

State-of-the-art

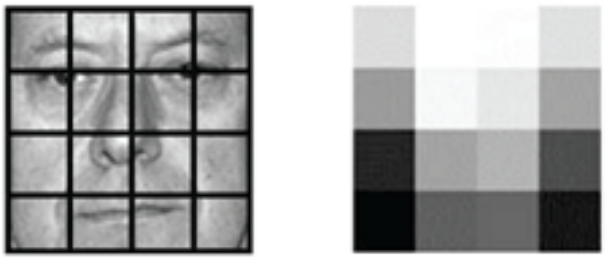


T. Ahonen et al., *Face Recognition with Local Binary Patterns*, 2004



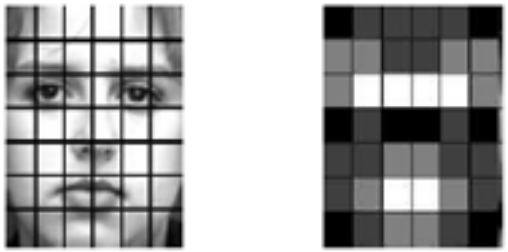
O. Nikisins and M. Greitans, *A mini-batch discriminative feature weighting algorithm for LBP - Based face recognition*, 2012

M. Biglari et al., *Illumination invariant face recognition using SQI and weighted LBP histogram*, 2013

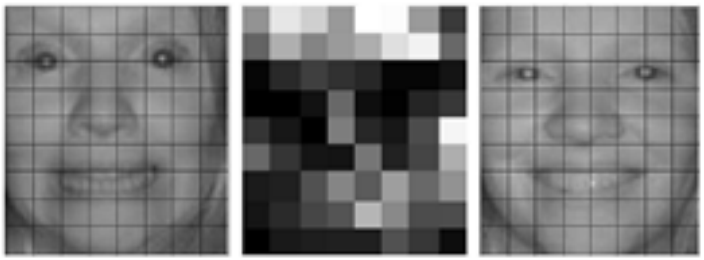


W. Biao et al., *Face recognition based on nonsubsampled contourlet transform and block-based kernel Fisher linear discriminant*, 2012

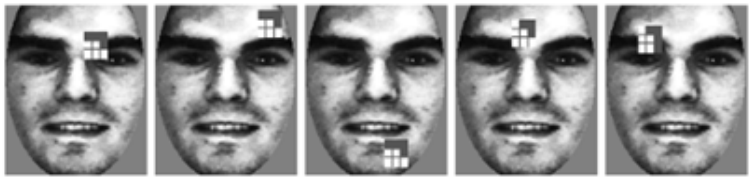
State-of-the-art



S. Caifeng et al., *Robust facial expression recognition using local binary patterns*, 2005



M. Taini et al., *Weight-based facial expression recognition from nearinfrared video sequences*, 2009



S. Z. Li et al., *Learning to fuse 3D + 2D based face recognition at both feature and decision levels*, 2005

G. Zhang et al., *Boosting local binary pattern (LBP)-based face recognition*, 2005

Databases

FERET

- collected at George Mason University
- grayscale, frontal view

BIG data sets

- BIG6 - 73 subjects, 531 samples, at least 6 samples / subj.
- BIG4 - 246 subjects, 1223 samples, at least 4 samples / subj.
- normalized images using eye coordinates
- histogram equalization
- masked irrelevant parts of image

P. J. Phillips, H. Moon, P. J. Rauss, and S. Rizvi, *The FERET evaluation methodology for face recognition algorithms*, 2000

Databases

JAFFE

- collected at Kyushu University
- grayscale, frontal view
- 7 facial expressions (6 basic emotions and 1 neutral)
- 10 subjects, 213 samples

M. J. Lyons, S. Akemastu, M. Kamachi, and J. Gyoba, *Coding Facial Expressions with Gabor Wavelets*, 1998

Feature extraction

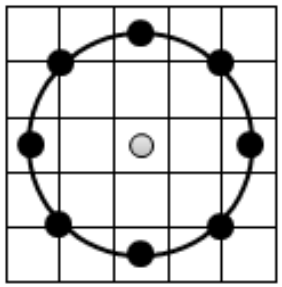
LBP (Local Binary Patterns)

$$LBP_{P,R} = \sum_{i=0}^{P-1} s(\overline{p}_i - \overline{p}_c)2^i \tag{1}$$

$$s(x) = \begin{cases} 1 & x \geq 0 \\ 0 & x < 0 \end{cases} \tag{2}$$

NRLBP (Non-Redundant Local Binary Patterns)

$$NRLBP_{P,R} = \min\left(LBP_{P,R}, 2^P - 1 - LBP_{P,R}\right) \tag{3}$$



$P = 8, R = 2$

Feature classification

Weighted χ^2 distance

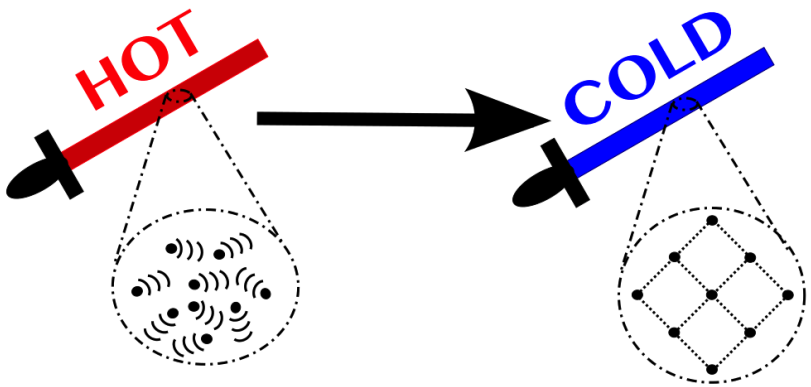
$$\chi^2(\overline{x}, \overline{y}, \overline{\omega}) = \sum_{i,j} \overline{\omega}_j \frac{(\overline{x}_{i,j} - \overline{y}_{i,j})^2}{\overline{x}_{i,j} + \overline{y}_{i,j}} \tag{4}$$

$\overline{x}, \overline{y}$ - row vectors

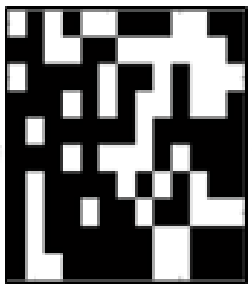
$\overline{\omega}_j$ - row vector of weight coefficients for region j

Simulated annealing

- optimization algorithm based on annealing in metallurgy
- probability function (temperature)
- acceptance of worse solution



Proposed methodology

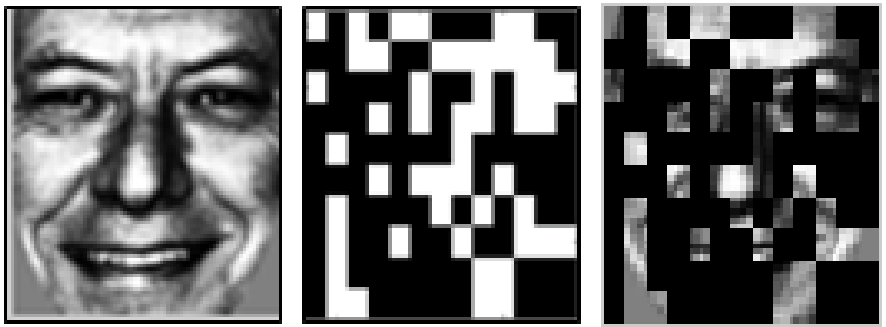


Objective function

- to maximize recognition accuracy
- to maximize number of true positive samples according to weighted χ^2 distance
- to find optimal weights for recognition

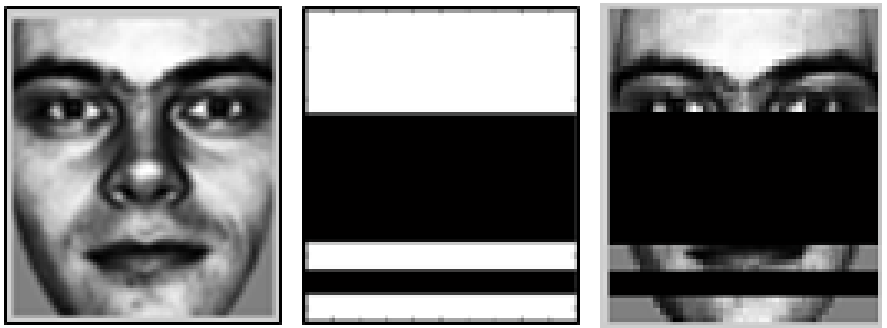
Experimental results

BIG4 database	
Feature type	$NRLBP_{8,2}$ $RIU2$
Size of one block [pixels]	4*6
Feature dimension without weights	1170
Feature dimension with weight "1"	450
Recognition accuracy without weights [%]	97.801
Recognition accuracy with weight "1"[%]	97.457



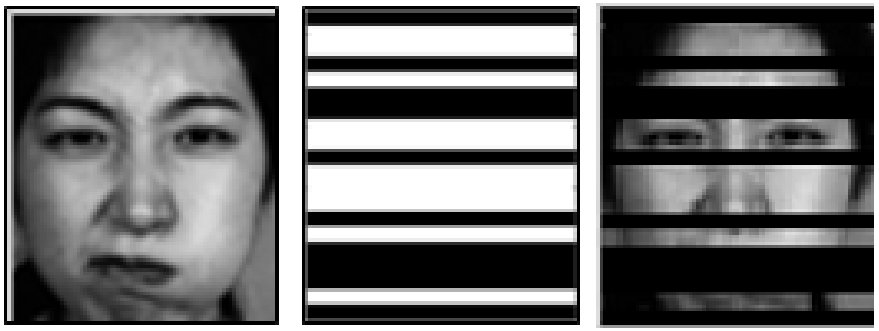
Experimental results

BIG6 database	
Feature type	$LBP_{8,2}$ $U2$
Size of one block [pixels]	52*5
Feature dimension without weights	708
Feature dimension with weight "1"	354
Recognition accuracy without weights [%]	99.096
Recognition accuracy with weight "1"[%]	98.996



Experimental results

JAFFE database	
Feature type	$NRLBP_{8,2}U2$
Size of one block [pixels]	52*3
Feature dimension without weights	600
Feature dimension with weight "1"	300
Recognition accuracy without weights [%]	97.933
Recognition accuracy with weight "1"[%]	97.674



Conclusions

- the important face parts identification based on simulated annealing
- feature dimension reduction
- well-preserved recognition performance
- symmetrical and asymmetrical block selection
- advantage - generality and additional parameters optimization
- limitation - computational complexity in case of time consuming recognition methods (SVM, NN, DNN)

Future work

- to analyse important face parts in detail
- to analyse block dimensions selection in detail

Discussion

Thank you for your attention

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